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The

Tropical Agriculturist

APRIL, 1941

EDITORIAL

RUBBER

ACCORDING to the authoritative statement published in the last Annual Report of the Ceylon Planters' Association, the area of old rubber replanted after the current Rubber Control Ordinance was passed in 1934 was slightly under 27,000 acres. This constitutes approximately $4\frac{1}{2}$ per cent. of the 604,000 acres under rubber in the Island. The peak of replanting activity was reached in 1937 followed by a slow but steady decline in the last three years. The complacency of the rubber grower in Ceylon evidenced by these disappointing figures justifies our return to a subject which was discussed editorially in this journal exactly three years ago.

The argument advanced in 1938 was based on the probability that the Governments which were parties to the International Agreement would not find it expedient to make rubber restriction a permanent arrangement in their respective countries. Subsequent events lend strong re-inforcement to this argument. In the first place there is no certainty, or even probability, that the political re-alignments that will be produced by the war will enable all rubber-growing countries to take concerted action for the control of production. In the second place the position and prospects of synthetic substitutes for rubber have improved considerably in the last three years. One lesson of first importance learnt from the present war is that it is unsafe for a country to depend for its supplies of an essential commodity on long-distance sea transport. We fear that the nations of the post-war world will find the substitute of an artificial product for natural rubber to be a means of escape from such dependence in respect of that very important commodity. For most purposes it is not inferior to plantation rubber. For some it is superior. Uniformity of quality is more

easily secured in the synthetic than in the natural article. In these circumstances rubber can retain even a part of its popularity in the market only by a very considerable disparity in price in its favour. It is reported that the cost of producing synthetic substitutes has come down to two shillings per pound from the pre-war figure of four shillings and six pence. This downward trend will be accelerated when the world is left with the scientific knowledge and experience accumulated during the war, but free from its stress and strain, so that shilling-a-pound Buna or Neoprene, though not exactly within sight, may yet be just round the corner. From a shilling to nine pence, and then to six pence—these are not inconceivable steps. The time must come when competition with artificial products will make it impossible to maintain a high price level for rubber by restriction.

The rubber grower in Ceylon must therefore face the fact that before long he will have to compete with his rivals in Malaya and the Netherlands East Indies in a contracted market. He has no chance of survival if he has an old plantation consisting of unselected trees which yield some five to six hundred pounds of rubber per acre while his rival has large selected clonal plantations with yields in the neighbourhood of 1500 lb. per acre. We therefore repeat our advice to him to replant all he can, and to do it while the rubber coupon market holds out to him the opportunity of doing so with very little loss.

THE PREPARATION OF ARECANUT FOR THE MARKET IN MYSORE WITH BRIEF NOTES ON ITS CULTIVATION

ANDREW W. KANNANGARA,
ASSISTANT TO THE AGRICULTURAL OFFICER, PROPAGANDA

CONSEQUENT on a motion in the State Council that early action should be taken to reorganize the areca industry in Ceylon, the Department of Commerce and Industries initiated certain inquiries which led to the recommendation that steps be taken to introduce the manufacture of the arecanut preparation known (in Mysore) as " chickani ". The consumption of this form of dried arecanuts, according to the Ceylon Trade Commissioner in India, is " on the increase and fetches very remunerative prices in the Madras market ", compared with the products exported to India.

This recommendation was submitted to the Director of Agriculture with the request that he should consider the desirability of sending an agricultural officer to study the preparation of " chickani ". With the sanction of the Ministry of Agriculture and Lands, the Director, therefore, deputed the writer to proceed to India.

In this article are described the various processes involved in the manufacture of this product. There are also brief notes on the cultivation of areca in Mysore particularly insofar as it differs from the processes obtaining in Ceylon.

GENERAL

Mysore State is a gently undulating plateau surrounded on three sides by a chain of mountains. For agricultural purposes this plateau divides itself into two main natural divisions—the *malnad* and the *maidan*—each with distinct characteristics of its own. The *malnad* consists of the hilly tracks of the west, covered by magnificent forests, a good portion of which is planted with major crops such as coffee, coconut and arecanut. The *maidan* area is more extensive. It consists of the rich alluvial plains of red and black soils in which are cultivated the annual crops that are so necessary for the well-being of any people.

The average rainfall ranges from 30 inches in the east to 250 inches in the west. In the north-east, there are places which receive only 15 inches in 12 months, but agriculture does not depend solely upon rain water. Extensive irrigation works have been constructed, of which the most important is the Irwin Canal Scheme which conveys the water of the Cauvery river hundreds of miles inland. These irrigation works bring under cultivation thousands of acres of *maidan* tracts which, under ordinary circumstances, would have remained unproductive.

In Mysore State, as in most other parts of India, at least 75 per cent. of the population are agriculturists. Of the crops raised by them, areca cultivation appears to receive particular attention. This is vastly different from conditions prevailing in Ceylon where the arecanut palm takes no place whatsoever among cultivated crops. Nevertheless, in Ceylon this palm has survived through the ages in the great struggle for existence ; so that to-day it occupies an extent of land covering nearly 70,000 acres. This acreage is by no means to be despised, for it out-figures Mysore, where arecanut is cultivated, by over 25,000 acres.

BOTANICAL AND LOCAL NAMES

The arecanut (or betelnut as it is popularly referred to in India) is botanically called *Areca catechu*, Linn. ; it belongs to the natural order *Palmae*. In the different provinces in India it is given various local names, the most popular of which are : Adike (Kanarese), Pakku (Tamil), and Supari (Hindi and Bengali).

HABITAT

The areca palm is considered a native of Cochin China and Malaya. It is now cultivated throughout tropical India including Burma and Ceylon.

DISTRIBUTION

I. Mysore State

District.	Acreage.	Yield in cwt.	Value of Crop. Rs.
1. Shimoga ..	16,000	80,000	2,560,000
2. Tumkur ..	10,000	50,000	1,200,000
3. Kadur ..	7,000	35,000	980,000
4. Hassan ..	3,500	10,500	252,000
5. Mysore ..	3,200	12,000	288,000
6. Bangalore, &c.	2,800	7,650	183,600
Total ..	42,500	195,150	5,463,600

II. Ceylon

District.	Acreage.	Yield in cwt.	Value of Crop. Rs.
1. Kegalla ..	22,000		
2. Ratnapura ..	9,000		
3. Kandy ..	9,000	These figures are not available for Ceylon.	
4. Colombo ..	6,000		
5. Kurunegala ..	5,000		
6. Matara ..	5,000		
7. Other Districts..	12,476		
Total ..	68,476		

SELECTION OF SITE

The most important consideration in the selection of a site for the cultivation of arecanuts appears to be the availability of an adequate supply of water. In the *malnad* or the rain-fed uplands of Mysore arecanut gardens are generally located in the valleys of hills adjoining tropical forests. These forests have the advantage of retaining sufficient moisture which the areca plantations can absorb during dry summer months. They act as natural wind-breaks, protecting the arecas from the effects of desiccating winds. They supply the necessary green leaf material for the crop, and fuel for boiling the nuts. In the dry areas of the State, however, arecanuts are cultivated wherever an adequate supply of water is available. It is not uncommon to find large and extensive plantations in these dry regions where tank irrigation is available or along the banks of rivers. Under normal conditions the areca palm thrives quite satisfactorily up to 3,000 feet in localities where the rainfall ranges from 80 to 250 inches. In Ceylon, areca thrives naturally up to 2,500 feet in the wet zone.

NURSERY

The method of raising nurseries varies in different localities. The most suitable method appears to be to plant the fruits in carefully prepared trenches. These trenches are half filled with river sand, fruits placed in them and covered with a layer of leaf mould. In some places, ripe fruits are dried in the sun for a day or two, then mixed with a reasonable quantity of rich moist soil and tied into bundles in plantain sheaths. After germination they are planted in a nursery near a good source of water. In other places the fruits are placed in heaps until they show signs of germination, when they are planted in nurseries. Another practice, which is rare, is to envelope the fruits in a thick layer of cattle dung and to plant them direct in the field after drying the dung.

Under Ceylon conditions it appears to be the common practice to plant the fruits in the field direct without even digging proper holes, or to transplant from a nursery when the seedlings are 6 to 12 months old. In Mysore at least two years are allowed

to elapse before seedlings are uprooted from the nursery. Planting *in situ* is hardly ever practised. The fruits are selected from the November pick, when the crop is considered to be at its best and from trees of vigorous growth which are reputed to produce the finest grades of dried nuts. Such trees are about 30 years old, and the fruits well formed with a thin shell and a pointed apex. The fruits are allowed to ripen in the trees themselves and, when two or three of them fall from a bunch, that bunch is considered to have attained the optimum stage of maturity, for purposes of germination. The fruits under these conditons are picked, dried for a day or two and placed for germination in the manner adopted in the particular locality.

VARIETIES

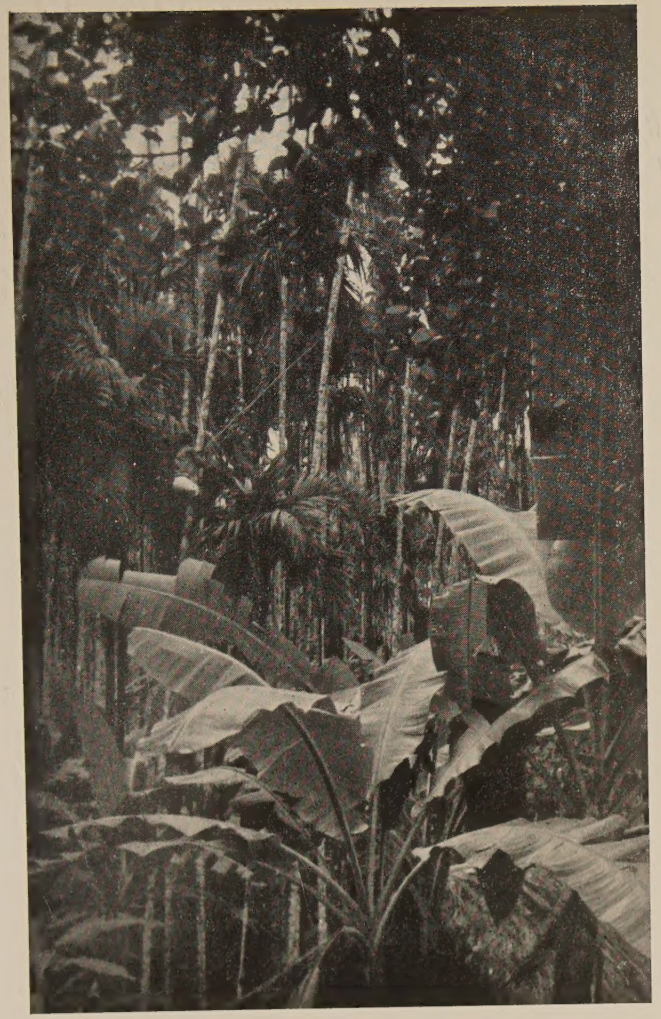
In Mysore, there are apparently no distinct varieties of edible arecanuts, though there are trees some with yellow and others with green fruits when immature. Differences in nut size are also seen. Whether these differences are due to the presence of distinct types, or to environmental factors, is not known. For purposes of drying, the size of the nut or the colour of the husk is immaterial.

In Ceylon there are at least two distinct chewing species, namely, *A. concinna* (Lenteri, Sinh.) and *A. catechu* (Puwak, Sinh.); the latter has three cultivated varieties known by the Sinhalese names of (*a*) Sinhala Puwak, (*b*) Rata Puwak and (*c*) Hamban Puwak. Recently three other varieties, *viz.* Borli, Severdhan and Mangalore have been imported from India, and are being tried at Eraminigolla Areca Station in the Kegalle District.

PREPARATION OF LAND AND PLANTING

When a suitable site is selected the land is cleared of all vegetation. Most of the stumps and roots are removed as far as possible. In the hills, a regular system of channels is constructed so as to include between two channels a strip of land sufficient to accommodate two rows of arecas. During the monsoons these channels are used for drainage purposes, and in the dry season they are utilized to irrigate the plants. There are instances where channels are so far apart that even three or four rows can be planted. In the Shimoga district, which is situated in the *malnad* area, however, in many gardens only one row of plants is permissible owing to the hilly nature of the land.

The beds are thoroughly hoed or ploughed and one or more rows of plantains are established at distances of 8 feet, according to the width of the beds. The plantains, in addition to being a profitable catch crop, act as a wind-break and supply shade to the young areca seedlings. (Plate I., fig. 1). They are allowed to grow for one year before the areca is planted. The areca



Block by Survey Dept.

Fig. 1—Plantains serving as a catch crop and windbreak in a young areca grove.

Block by Survey Dept.

Fig. 2—Arecanuts. (The bunch on the left is affected with *Koleroga-Phytophthora* sp.)

plants are usually planted, in the same row as the plantains at distances of 8 feet. When the areca plants are well established, pepper vines are trained to them and cardamom root-stocks are planted along the channels. This completes the first cycle of the arecanut plantation.

After about 20 years a fresh supply of areca seedlings is planted between the original row so as to replace the first planting which will become unproductive about the time the new trees put forth a good crop. Regular cultural and manurial programmes as detailed elsewhere are carried out and vacancies filled.

In the *maidan* or the drier plateau the cultural operations are more or less the same, but the land is not divided into alternate rows of ridges and furrows unless it has a tendency to water-logging. Cardamom and pepper are replaced by coconut and the betel vine. In Ceylon, arecanuts are not subject to any form of systematic cultivation.

The areca seedlings are allowed to remain in the nursery for about two to four years before they are planted out. Planting is usually carried out immediately after the main south-west monsoon rains in August and September. The holes are made $1\frac{1}{2}$ to 2 feet deep and 3 feet square. In sandy soils, holes of greater depth are preferred.

The first crop can generally be expected about the 10th year, but under good cultivation the trees may bear in 8 years, so that the land has to be well maintained for at least 8 years before any return can be expected from it. It is for this reason that so much importance is paid to catch crops. In Ceylon, areca trees begin to bear even in the 6th year and in the 8th year a satisfactory crop is possible.

The annual recurrent expenses on maintaining an acre of land under areca in Mysore are fairly high. They include the following cultural operations in addition to expenses on spraying against *Koleroga* (*Phytophthora* sp.), and on land tax. Plate I., fig. 2.

1st year : Hoeing and the application of farmyard manure at the rate of one basket per tree, or 15 to 20 tons per acre.

2nd year : Application of F. Y. M. and green manuring. Each tree receives about 35 lb. of green leaf to supplement the F.Y.M.

3rd year : No treatment.

4th year : As in the first year and so on.

The expenditure on maintaining an arecanut garden in Mysore is about Rs. 75 made up as follows :—

		Rs.
1.	Manuring	35
2.	Hoeing, &c.	20
3.	Land tax	10
4.	Spraying	10
	Total ..	75

It is unfortunate that none of these cultural operations are carried out in Ceylon. Judging from the results now obtained, Ceylon areca should give very remunerative yields if only it received a part of the attention given in Mysore.

PESTS AND DISEASES

A number of pests and diseases of the areca palm has been recorded in Mysore, but none are so harmful as *Koleroga*, (*Phytophthora omnivora*, var. *arecae*) and *Anabercga* (*Ganoderma lucidum*). The annual losses caused by the former disease alone are estimated at Rs. 400,000.

Koleroga.—The symptoms of the disease are the rotting and the consequent falling of immature nuts during the south-west monsoons. In the Shimoga District where very heavy rain is experienced, the fungus attacks even the crowns of palms and causes a rot of the buds.

The control measures recommended are the removal of the affected portions and their destruction by fire, and the spraying of the bunches regularly from the end of May throughout the rains with a 2 per cent. solution of Bordeaux mixture. This is obtained by mixing the ingredients in the following proportion :—

$CuSO_4$	..	..	.. 5 lb.
Quick lime	..	..	.. 5 lb.
Water	..	..	.. 25 gallons

Cultivators are alive to the importance of spraying to control this disease and spraying is carried out regularly. The officers of the Department of Agriculture, Mysore, who are stationed in areca-growing districts are provided with a stock of spraying machines which are used for the spraying of palms of cultivators who are unable to purchase machines of their own.

Anaberoga.—This fungus usually attacks the roots and the base of the stems rendering the affected parts dry and brittle. The more common symptoms are the poor growth of the crown and the yellowing of the leaves. As the disease advances, bracket-shaped fructifications appear at the basal regions of the palms.

The remedial measures which are simple and efficacious consist of the destruction of the dead and diseased portions and the subsequent application or sulphur dust at the rate of half to one pound per palm over an isolated ring of land which includes the suspected trees.

Anaberoga is most prevalent in the *maidan* and the *semi-malnad* areas.

HARVEST

The stage at which the fruits are harvested is an important factor in the preparation of the dried product. The best quality can only be produced with those nuts which are moderately firm to the touch and from which no liquid oozes out.

They should contain only a limited quantity of tannin. The stage of maturity is generally tested by the insertion of the pointed end of a knife into the nut. If penetration takes place with only slight pressure it is considered sufficiently mature for curing. Those that do not conform to these conditions are considered unfit for proper curing and the finished product is of a poor quality. In Ceylon fruits are plucked when they are either very tender or fully mature.

With reasonable correctness observant land-owners are able to predict the time of harvest, from the date of appearance of the inflorescences. A few of these may open during off seasons, but they are ignored, as they invariably mature during the rains when it is both difficult and dangerous to climb the trees to pluck them. In Ceylon the cropping season goes on from August to March and two or three pickings of three to four bunches are possible. These trees appear to be more productive than those of Mysore. The main cropping season in Mysore is about August to January and this is done on three occasions. In the first plucking, only about a quarter of the season's crop is collected ; the second plucking which falls in October or November is the most important in that the bulk of the fruits is available at this time. This really becomes a rush season and all effort is made to expedite the boiling and drying processes. The last harvest is the smallest and depending on weather conditions this may continue until January.

The process of harvesting the fruits is as interesting as it is varied. The best method is that in which the bunches are brought down without the separation of any of the fruits. In order to do this, a man suitably attired climbs a tree from which most other trees are approachable. His dress consists of :—

(*a*) A seat on which to rest so that he may be at ease when plucking the bunches.

(*b*) A breast plate made of areca spathes to protect his chest from abrasions.

(*c*) A loop for his legs to facilitate a good grip on the trunk of the tree while climbing. This is removed when the seat is used.

(*d*) A belt with a ring to support the long rope which helps to lower the bunches.

(*e*) A long bamboo at one end of which a hooked knife is attached for pulling the neighbouring trees within reach to pluck the bunches with his hands.

(*f*) Some hooks to fix the tree pulled by the bamboo towards the one to which the climber is clinging. Plate I., fig. 1.

Thus equipped he climbs the trees, takes his seat apparently in a comfortable manner, and with great dexterity wrests the bunches from the trees only to lever them along the long rope, one end of which is hooked to his belt and the other end held taut by his assistant on the ground. He plucks an average of 150 bunches a day and is paid at the rate of Rs. 5 per 1,000 bunches.

In some localities the bunches are cut and pulled down by means of a curved knife attached to a long bamboo. As they drop, a wide blanket or mat which is held firm by four persons is outstretched to receive them. In other localities, the momentum of the falling bunches is reduced by the throwing up of jute hessian bags to meet them. The bunches become entangled in the bag and reach the ground with reduced speed, somewhat similar to the action of a parachute.

These contrivances aim at reducing the damage caused to the nuts by their impact with the hard ground. Nevertheless, there are persons who allow the bunches to fall on the bare ground and then collect the scattered fruits.

The bunches, or the fruits as the case may be, are now collected and brought to the godown. To detach the fruits, the bunches are raised by a strong rope which is passed through two tough spadices, and beaten on a wooden base. In a few seconds all the fruits are released from the spadices. A labourer receives Rs. 5 for detaching the fruits from 1,000 bunches, which he himself has to transport to the godown.

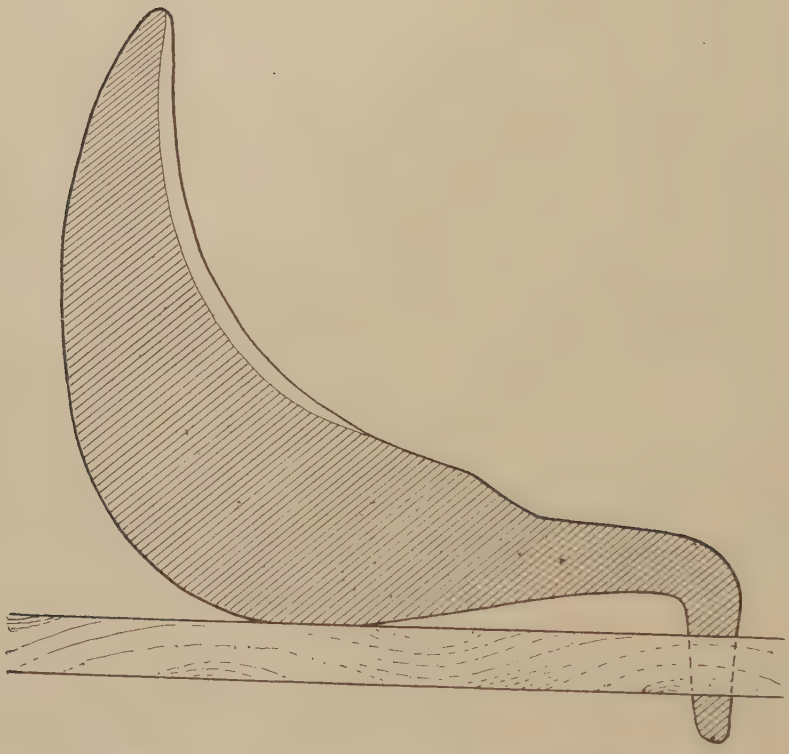
YIELDS

The usual number of trees per acre in a cultivated garden is 400, and the average yield per tree is 2 or 3 bunches. Each bunch contains about 200 to 250 fruits. The yield per acre, therefore, is 160,000 to 300,000 fruits. About 28,000 fruits produce a hundred-weight of the prepared product and the annual return from an acre works out at 6 to 10 cwt. Sinhala Puwak yields better than most of the varieties in Mysore, the average being about 3 to 4 bunches per tree, each bunch containing 200 to 400 fruits. The number of fruits per acre is about 240,000 to 640,000 with the same stand of trees.

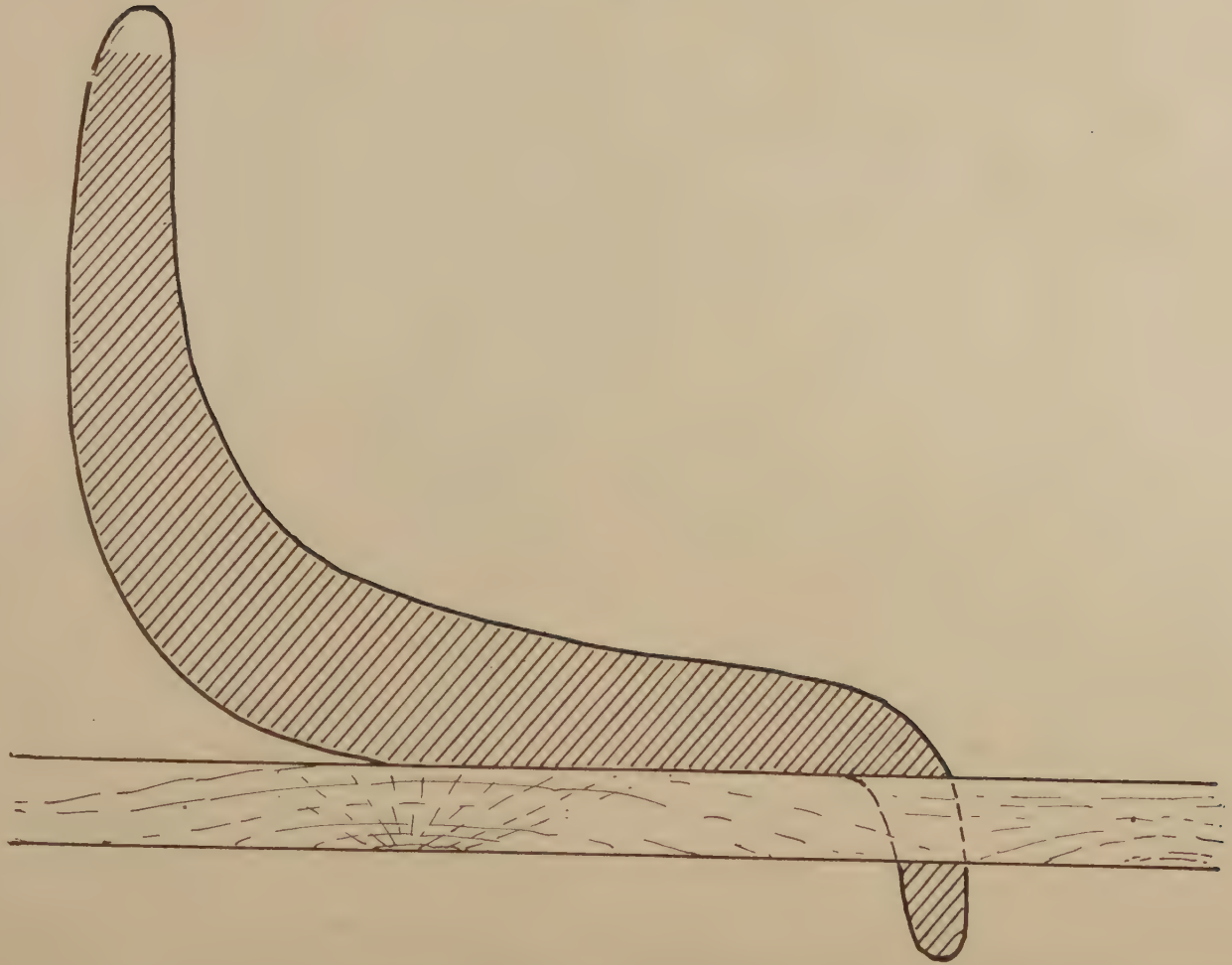
THE PREPARATION OF *CHICKANI*

1. SHELLING AND SLICING

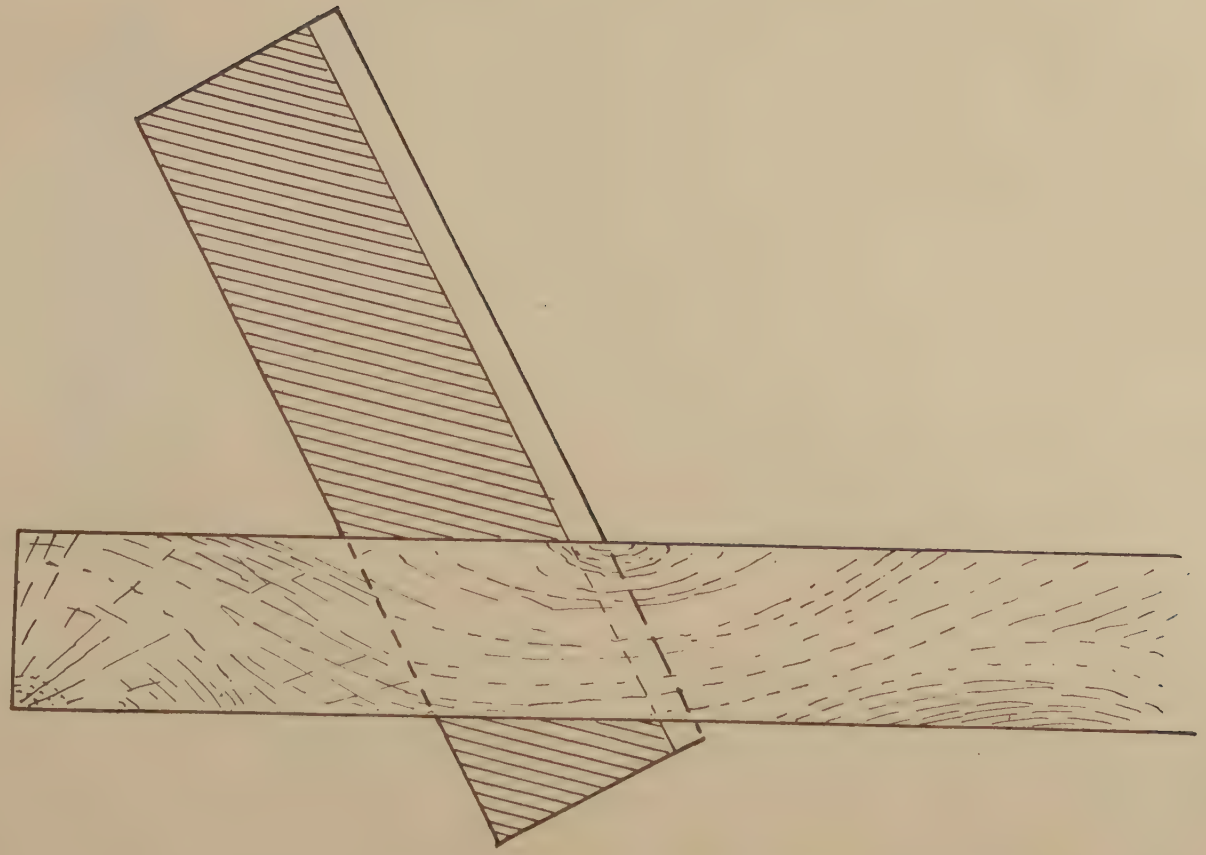
The next operation is that of shelling and slicing. In order to obtain a good quality product for the market shelling should commence almost immediately after plucking. If immature fruits are plucked they are left in the godown for a day or two



Shelling and slicing knife with a curved blade (half size).



Shelling knife with a curved blade. The point of the blade is used for shelling



The straight-bladed knife showing how it is fitted to the wooden plank on which the sheller sits. This knife is used both for shelling and for slicing.

so that they may harden while resting. Shelling is often delayed when dark and sultry weather conditions prevail. In such cases it becomes more profitable to commence shelling immediately, and to resort to artificial drying than to await fine weather. In any case, nuts should not be left unhusked for more than three days.

The instruments for shelling are sharp knives, the edges of which are either concave or straight. The blade is firmly fitted to a strong wooden plank on which the sheller can sit. The curved instruments are of two kinds—the one has a sharp blade and the other a sharp point. (Plates II. and III.) The sharp-edged knife is used both for shelling the fruit and for slicing it, whereas the sharp-pointed one can do only one operation, namely, shelling. In this case another knife has to be used for slicing, thus delaying the work for sometime (Plate IV). But this does not make the work more expensive, as the labourers are paid according to the quantity of fruits shelled.

In shelling, the ideal to be aimed at is an unbruised nut with the thin membraneous tissue covering it intact. Injured nuts present a poor appearance and consequently fetch a lower price in the market.

It is likely that on shelling there will be a number of over-ripe fruits to which some portions of the shell will adhere. These are generally kept in water for about a day when it becomes easy to remove the shells. In principle, the methods adopted for shelling and slicing the nuts are the same in both countries. The Mysore knives appear to give a larger out-turn of nuts per hour than the scissors-like arecanut cutters used in Ceylon. The green fruits yield 35 per cent. nuts and 65 per cent. husks by weight.

Shelling is undertaken only by trained labourers. It is not everyone who can acquire the swiftness that is expected of the shellers. During their training they invariably receive a number of cuts on their palms even when they are well protected with a thick pad.

In slicing the nuts the common practice is to cut them into two. But if sufficient labour is available they are cut into smaller sections or even chipped into finer pieces. These fetch a better market price which more than covers the extra labour involved. The nuts may be sliced into fours, eighths, sixteenths, or into still finer pieces. Some of them resemble cloves in shape. These are popularly known in the market as " Lavanga Chooru " or " Koch-adike."

2. BOILING

Arecanuts are boiled to bring them into the correct degree of palatability. In the process of boiling, excess tannin and mucilage are removed and a certain amount of foreign tannin

is infused into them. It is partly in order to infuse this tannin and partly to obtain a good colour that the liquid of the previous season's boiling is mixed with fresh water for the new nuts. This liquid is absorbed into the nuts, thereby preventing a fibrous nature in the finished product.

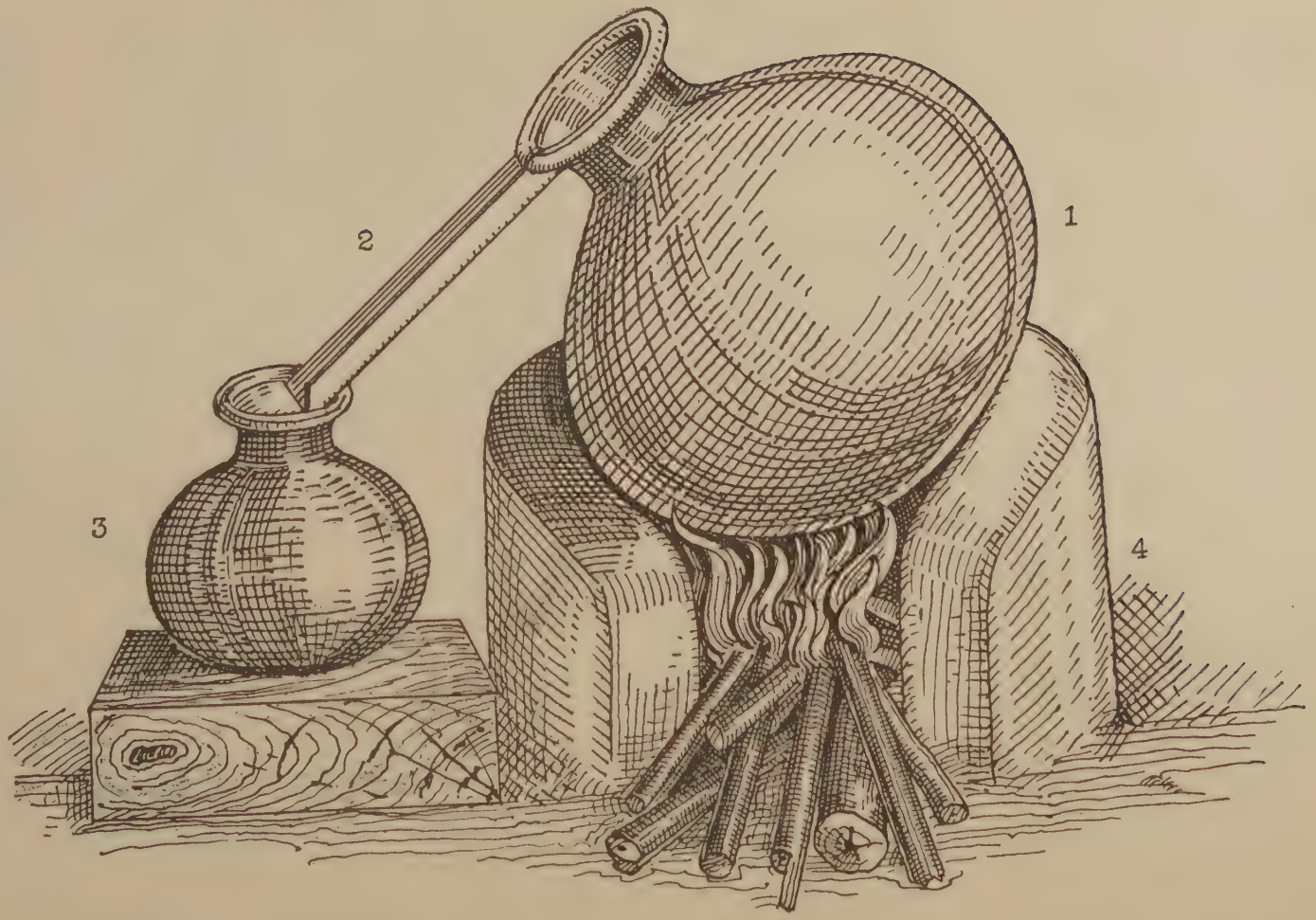
The nuts are boiled in a mixture of water and catechu decoction (which is no more than the liquid of the previous year's boil referred to above) in a copper or earthen vessel from $1\frac{1}{2}$ to 3 hours over a steady fire. When they are sufficiently boiled the embryos drop out, and the cut surfaces assume a slightly concave appearance. The decoction is strained off through bamboo baskets or through perforated ladles before removal for drying. If it is anticipated that soon after boiling the nuts cannot be sun-dried owing to wet weather, instead of boiling them, they should be kept immersed in water for a day or two. As soon as the boiling of one lot is over the pot is again charged with fresh nuts and into the decoction from the previous boil sufficient fresh water is poured to fill the pot (Plate V.).

The boilers are usually of copper, but earthen vessels can be used, though these suffer from the disadvantage that they do not last long. However, the poorer classes who cannot afford copper vessels can use them. Where the decoction or the starter, as it is popularly called, is not available, the nuts are boiled in fresh water and coloured later.

There are many organic and inorganic ingredients in use for obtaining a good colour. But none produces so good a colour as the natural one imparted on boiling with the catechu decoction. The decoction obtained on boiling with fresh water can be used again and again and until about the third or fourth occasion when the correct consistency is obtained. Those boiled in fresh water must be rubbed with the inspissated decoction after the nuts have been dried in the sun for about three days so as to impart to them a good colour. But this colour may not last long.

Some material used for artificial colouring are (1) betel vine (2) slaked limestone, (3) catechu from *Acacia catechu*, (4) bark of *Eugenia jambolana*, (5) bark of *Ficus religiosa* and (6) sandal-wood bark. Although these ingredients are used by the arecanut growers, the Government of Mysore are not prepared to recommend them as experiments have not yet been carried out by the officials.

The catechu decoction can be used the next year kept either in liquid or in solid form. The solid form is obtained by thickening and drying the liquid. Fastidious folk on occasion boil the nuts in milk. This is only for personal use.



Boiling of arecanuts.—(1) Copper pot. It should be slightly tilted.
(2) Funnel to drain off the frothy water.
(3) Pot to collect the drained-off water (catechu).
(4) Fireplace.

3. DRYING

The next operation is to dry the nuts. Drying is generally done over barbecues about 8 feet in height. The reason for using tall barbecues is perhaps to prevent pilfering. Otherwise lower and more accessible drying floors are preferred. Spreading the nuts over stones when available will serve the same purpose. The nuts are dried from about 6–9 days depending on the intensity of the sun. If uncertain weather conditions are likely to prevail for over three days, it is advisable to dry the boiled product in flue barns.

The actual expenses incurred in the production of the dried nuts are :—

		Rs.	c.
1.	Harvesting of 1,000 bunches, *i.e.*, produce of nearly one acre	5	0
2.	Bringing to shed and clearing	5	0
3.	Shelling and slicing	5	0
4.	Boiling if paid labour is used	1	0
5.	Drying if labour is used	1	0
	Total ..	17	0

	Rs.	c.
Yield of dried nuts, say, 6 cwt. at Rs. 35 ..	210	0
Total expenses Rs. 75 × Rs. 17	92	0
Depreciation of appliances, &c.	8	0
.. Nett profit ..	110	0

Cost of Appliances

		Rs.	c.
1.	2 boilers @ Rs. 15 each	30	0
2.	1 open copper vessel	15	0
3.	1 funnel and pot	4	0
4.	1 perforated ladle	1	0
5.	2 baskets for straining	1	0
6.	Setting up 1 barbecue	5	0
7.	100 mats	10	0
8.	10 knives	5	0
	Total ..	71	0

These appliances will last for 15 years.

4. GRADING

Grading of dried arecanuts is an art which can only be acquired after considerable amount of experience of the market requirements. The best quality consists of tender sliced nuts and the most inferior is the ripe whole nut. In Mysore, the tender nuts

as well as the ripe nuts are subject to the same process of boiling. Between these two grades are a number of other grades, the more important of which are detailed below.

A. Chickani adike—tender nuts cut into two.
B. Chooru or Koch-adike—tender nuts sliced into several small pieces.
C. Idi adike—unsliced nuts.

These are again sub-divided as follows :—

A. Chickani adike (Synonyms : Holu, Jibbu, Saraku) has the following sub-grades in order of merit.

(1) Hassar or Chickani—Rs. 55 per cwt. Those that can be accommodated to the greatest height when sliced tender nuts are placed one over the other, form this grade. These will invariably be the embryo ends of the nuts.
(2) Petin—Rs. 50 per cwt. Saucer-shaped bottom half of the nuts.
(3) Raja alu—Rs. 45 per cwt.
(4) Dala—Rs. 42·50 per cwt.
(5) Sanna bette—Rs. 40 per cwt.
(6) Bette—Rs. 35 per cwt.
(7) Goravalu bette—Rs. 32·50 per cwt. Oldest nuts to which the shell clings.

B. Chooru or Koch adike—To this group falls the finer slices. The most popular sub-grade of this variety is the clove-shaped slices or "Lavanga Chooru".

C. Idi adike.

(1) Chickani idi—tender whole nuts,

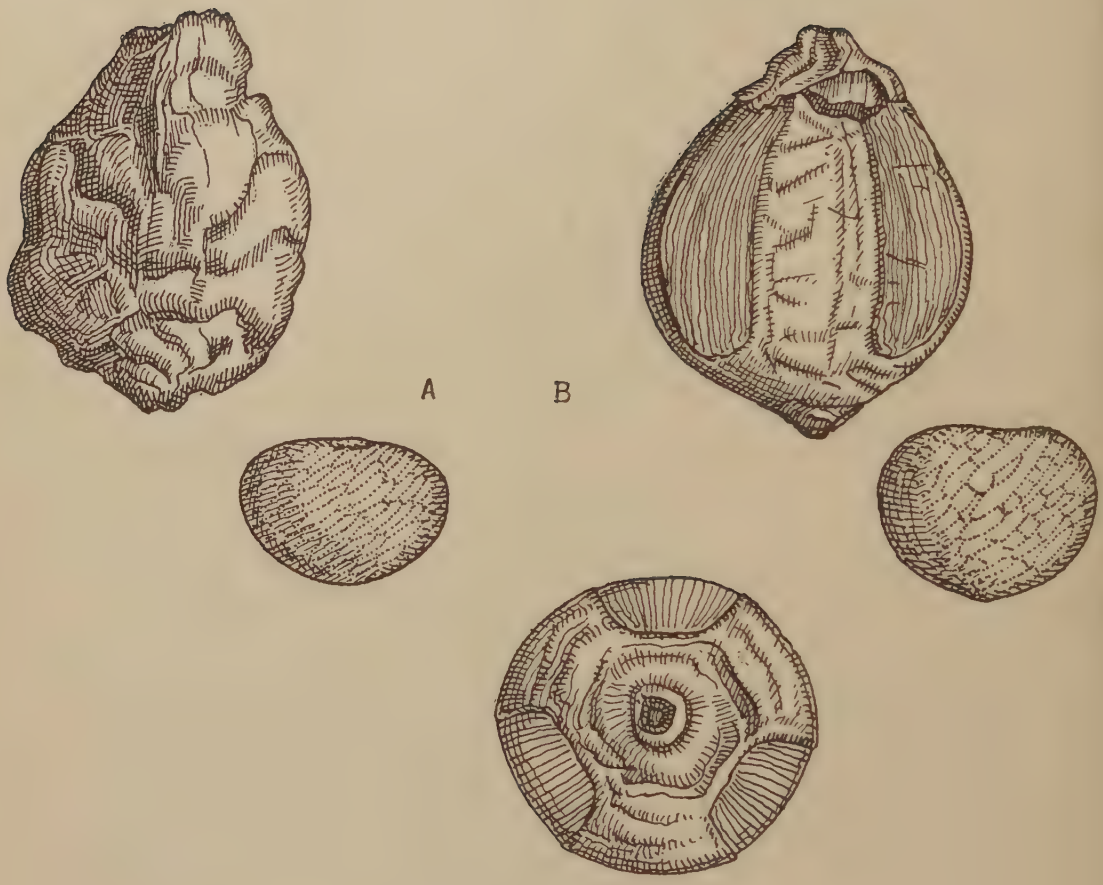
(*a*) Api—those with a depression on top.
(*b*) Rete—others.

(2) Ara bette or Bette idi—more mature nuts than (*a*).
(3) Gorabalu—shrivelled entire nuts, may be due to diseases.
(4) Gotu—those with clinging shell.

The dried nuts are thus graded and sold in the open market or are taken to the Shimoga Co-operative Stores. They fetch from Rs. 32·50 to Rs. 55·00 per cwt., according to the quality and the demand in the market. The *malnad* nuts are generally sold at Rs. 35 per cwt. and, as a yield of about $6\frac{1}{2}$ cwt. per acre can be obtained, a gross return of about Rs. 200 per acre is possible. In well-cared-for gardens a gross income of over Rs. 400 per acre is not uncommon.

OTHER PREPARATIONS

Of the other preparations, preserved whole nuts in husks are the most important. (Plate VI.) There is a demand for this variety in the *Supari* markets of Bombay and Calcutta and the ruling market price is Rs. 15 per cwt. To obtain quality produce of this grade, certain varieties of fruits are required, unlike for Chickani preparations where the size and the quality of the fruit are immaterial. Those that best lend themselves for drying according to this method are the *Borli* and *Severdhan* varieties. In order to obtain a fine quality of dried product in which the



" Karunka " or dried arecanuts.
A.—Ceylon method which causes shrivelling of the nuts and fungus growth.
B.—Indian method which gives a well-formed nut of superior quality.

nut is not mildewed or shrivelled, ripe fruits are plucked and the husks lightly stripped in about three places (Plate VI B). They are then dried in the sun and kept in a cool dry place stacked in gunny bags. Ten thousand ripe nuts go to form a hundred-weight of the dried product.

In Ceylon mature whole nuts are dried and marketed under the name " Karunka " or " Kotte-pakku " (Plate VI A). This preparation is considerably inferior to the product found in the *Supari* markets of Bombay or Calcutta. This inferiority may be attributed to :

(1) The dimunitive size of the local Sinhala puwak.

(2) The indifferent method of drying.

(3) The poor keeping qualities of the nuts.

(4) Mildewed and discoloured appearance of the cut surface of the nuts.

These defects can easily be overcome. An imitation of the Chickani preparation, too, is produced in Ceylon. This is known as " Petipuwak " or " Kalli-pakku ". In this case, very tender nuts are put on the market after being sliced and dried. Both these products, " karunka " and " peti-puwak ", need considerable improvement if they are to find a reasonable market in India where nearly 90 per cent. of the Ceylon produce is disposed of. The quantity exported from Ceylon shows a gradual reduction every year. In 1939, the total quantity sent out was 94,407 cwt. valued at Rs. 1,190,731, of which 77,462 cwt. were bought by British India at the rate of about Rs. 13 per cwt. These figures are considerably below those obtainable for the last 10 years. Mysore preparations are sold in Indian markets at rates varying from Rs. 32·50 to Rs. 55 per cwt. so that the poorest Mysore preparations fetch about Rs. 15 more than the best variety from Ceylon.

CONCLUSION

The tendency to produce inferior marketable goods is a weakness of the Ceylon villager. It needs to be corrected. With such an assured and lucrative market so near at hand, there is no reason why the highest grades of arecanuts should not be produced in Ceylon.

The cost of local production is much lower compared with that of Mysore. Here the cost of cultivation is almost nil, but the yield per acre appears to be considerably higher than in Mysore even where particular attention is paid to cultivation processes. *Sinhala puwak* comes into bearing from 6 to 8 years, whereas the Mysore varieties do not yield a satisfactory

return even in the 10th year. In Ceylon no expense is incurred on irrigating arecas nor has the need so far arisen to combat serious diseases such as *Phytophthora omnivora* var. *areca* or *Ganoderma lucidum*. Furthermore, the extent locally under areca exceeds that of Mysore by over 25,000 acres.

In consideration of these facts, Ceylon should be able to face competition from any part of the world where areca is cultivated, provided the nuts are prepared in the manner required by the import markets. Thus could Ceylon revive a decadent industry and bring about happier conditions among the areca growers—a voiceless people preyed upon by the merciless middlemen!

ACKNOWLEDGEMENT

The writer's thanks are due to the officials of the Department of Agriculture, Mysore, for the assistance given him to learn the processes enumerated above, within the short period of two weeks. He is also grateful to Dr. W. R. C. Paul and to Mr. W. Molegode of Peradeniya, for kindly reading over the manuscript and making valuable suggestions.

HARVESTING, CURING AND GRADING OF CIGARETTE TOBACCO

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HARVESTING

RIPENING of leaves commences from below and proceeds upwards. The tobacco crop should be ready for harvesting about four weeks after topping, but no fixed dates can be laid down. The condition of the leaf should be the sole guide in judging the correct stage for harvesting the crop. The leaves should be judged from a little distance as the colour may be deceptive when looked at from nearby. Locate the highest matured leaf on the plant and start picking from these downwards. The harvesting of tobacco for flue-curing is very important, since properly-grown tobacco is often spoilt through wrong methods of harvesting. Ripening is indicated by the change in the colour and the texture of the leaves.

The deep green colour of healthy, light-textured leaf changes by gradual degrees to a greenish yellow as the leaf reaches maturity, whilst in the case of heavy-textured leaf the change to a yellow colouration may be confined only to small areas of the leaf surface causing the ripe leaf to appear with yellow flecks or spots. The accumulation of starch granules within the cells causes the leaf to become brittle and roughened, this change from being pliable and smooth to the touch is another indication of ripeness. Such leaf will crack when folded and pressed between the finger and the thumb.

For flue-curing, tobacco should be fully ripe when placed in the barn. Tobacco picked before being fully ripe shows, when cured, a greenish colour and this tobacco is of very little commercial value. On the other hand over-ripe leaves are uneven in colour and brittle when cured. For flue-curing it is very essential that all the leaves should be in the same stage of ripeness and texture, as otherwise all the leaves will not yellow at the same time in the barn. Five to seven pickings are necessary for the complete harvest of a field. Two to three leaves can be harvested from a plant at each picking.

Start harvesting early in the morning before any wilting has taken place, *i.e.*, while the leaves are still wet with dew. Every effort should be made to complete the picking before the sun becomes too hot. Tobacco should not be harvested too soon after heavy rains, since rains wash from the leaves soluble gums, oils and resins which facilitate curing. If the leaves resume a greenish appearance the tobacco should be left until signs of maturity reappear. The leaves are primed from the plants as they ripen and placed in shallow baskets and carried on to the shed where they are strung together for hanging in the barn. The bottom and the middle leaves are the most valuable, and great care should be taken of them. The leaves should not be allowed to remain in the sun and get sun-scorched. Bruising of leaves should also be avoided. It is essential to fill the flue-barn in one day and commence the curing operations in the same evening, as a day's difference in the time of harvesting may result in the tobacco harvested first having yellowed or wilted much more than that harvested last. Should a certain quantity of tobacco be of heavy body it should be placed on the top tiers and the lighter-bodied tobacco on the bottom tiers.

STRINGING AND FILLING

Two sets of sticks are required for a barn. Strong round jungle sticks could be used for this purpose with advantage. Strong soft twine is tied to one end of the stick and it should be cut off at a point two and a half times the length of the stick. The stick is supported by means of a wooden frame.

The tobacco is placed in bunches of three to four leaves depending on their size and are held together with the backs of their mid-ribs touching one another. The person tying holds the string in one hand and the bunch of leaves in the other and the string is wrapped round the bunches one inch from the butts and the bunches are turned over and across the stick to form a draw twist. The next bunch of leaves is placed on the opposite side of the stick so that the alternate bunches will balance. Bunches are placed from two to three inches apart depending on the size of the leaf. The free end of the string is fastened through a slit at the end of the stick. Start filling the barn from top to bottom and place sticks at six to eight inches apart. Each stick four and a half feet long should carry 24 to 30 bunches of leaves. Crowding of sticks should be avoided, since drying is thereby retarded and sponging facilitated.

FLUE BARN

Special barns are necessary for the curing of cigarette tobacco. These barns are known as flue-barns because of the use of flue-pipes for heating the barns. Barns should be constructed on a level site in close proximity to the homestead on a tobacco

field because this will facilitate the supervision of work. A water supply should be available at the barn. The building should be so located that the prevailing winds do not blow through the furnace.

The size of a flue-barn to be erected on a holding will depend on the area of tobacco usually grown each year in the scheme of rotation to be adopted. The minimum economic unit required for the erection of a barn should be about 10 acres. Small flue-barns are better than big ones because it is very essential to fill a flue-barn in one day.

Furnaces are turned out of cast iron and the cost of these will depend on the weight of cast iron, so it is essential to use a furnace of minimum size. A furnace 3 feet deep, $1\frac{1}{2}$ feet wide, $2\frac{1}{2}$ feet high will serve to heat a barn 16 feet by 16 feet, 20 feet high. It is a great mistake to erect a barn of too great a height, because curing does not take place uniformly in the upper tiers. A permanent barn would be more preferable to a temporary barn in order to obtain the best results with the least risk of failure. The best size of a flue-barn is 16 feet by 16 feet by 20 feet high. Such a barn will hold leaves of four acres of tobacco at a time, *i.e.*, six to seven hundred sticks of tobacco.

Emil J. Livera has described in detail the construction of flue-barns, furnaces and flue-pipes, in *The Tropical Agriculturist*, Vol. LXXXV., September, 1935, hence the writer does not propose to go into details on these questions.

METHOD OF CURING

The aim of the grower is to cure leaves a rich lemon colour. A crop of tobacco properly grown and harvested may be completely ruined by wrong methods of curing. A good deal of skill and attention is therefore required by day and night. Curing means the correct manipulation of the temperature and humidity of the barn, after the barn has been filled with leaves, so that the yellowish green colour of the leaf when harvested is gradually changed into a rich lemon colour. The moisture content of the leaf too is considerably reduced. During the process of curing, the leaf is subjected to a series of chemical changes.

No hard and fast rules could be followed in flue-curing of tobacco. The grower should modify the methods of curing to suit the local conditions. The following factors influence the duration of the curing processes :—

(1) Soil;
(2) Climate;
(3) Cultural operations;
(4) Degree of ripeness of the leaf.

The writer has found the process described below good for conditions obtaining at Wariyapola.

The process of curing falls into three stages :—

(1) Yellowing of leaf;
(2) Fixing the colour;
(3) Drying the leaf—both web and mid-rib.

YELLOWING

The barn should be evenly filled taking care that no large spaces are left between the leaves and the sticks. If the quantity of leaf is insufficient completely to fill the barn, the sticks should be evenly placed over a few tiers. Then a reliable thermometer and hygrometer are hung below the last tier of leaves somewhere away from the furnace, preferably in the middle of the barn so that the reading could be easily taken through the pane in the window provided.

The time taken in yellowing the leaf varies according to the conditions of the leaf, hence the extreme importance of harvesting leaves of the same stage of ripeness in order to secure a uniform barn load. The yellowing of the leaf is the outward symptom of the slow starvation process which is taking place in the cells and the temperature and the humidity in the barn should have to be so adjusted that this process will take place with maximum efficiency. A small fire is started in the furnace and the temperature kept at 80 to 100° F. and a high humidity of not less than 80°. The yellowing of leaf proceeds more successfully at a moderate temperature of 80 to 100° F. and a high humidity not less than 80° and should be completed in 30 to 40 hours, after which the temperature should be raised to fix the colour.

Since it is impossible to get a barn-load with leaves all of which are in the same condition, yellowing will not proceed uniformly all over the barn, and one of the difficulties is to judge correctly the precise moment at which it is most advantageous to stop the yellowing process. The leaves which are allowed to yellow too much will not retain their colour in the later stages of curing, but will turn brown ; on the other hand leaves which have not yellowed sufficiently will be fixed with a greenish tinge. It is better to err on the green side as these leaves will improve their colour in bulk. During the yellowing stage the temperature should be slowly raised and all the ventilators and doors should remain shut to keep the humidity high. If the humidity in the barn goes below 80° it should be raised by artificial means. This could be done by placing wet gunny bags over the flue-pipes. The floor of the barn

should not be watered as this will cause sponging of leaves. The rate of raising the temperature during the yellowing process should be as follows : —

From start to 3 hours	.. ..	80° F.
4th to 8th hour	.. ..	85° F.
9th to 14th hour	.. ..	87½° F.
15th to 20th hour	.. ..	90° F.
21st to 23rd hour	.. ..	92½° F.
24th to 28th hour	.. ..	95° F.
29th to 34th hour	.. ..	97½° F.
35th to 37th hour	.. ..	100° F.

If the leaf is very thick the time taken for yellowing will be longer and the temperature should be raised more slowly. The leaves on the lower tiers just above the furnace and over the flue-pipes next to the furnace will dry early. To prevent this cover the furnace and the main flue-pipes with wooden planks.

FIXING THE COLOUR

The green leaf contains about 80 per cent. of water and in fixing the colour this moisture has to be driven off. To do this successfully the moisture must be removed as fast as it is given off by the leaves and therefore the ventilators must be opened and the temperature raised. This is the most critical stage in the process and most of the failures to secure good colour occur at this stage. The two chief difficulties are scalding and sponging of leaf. The former is caused by raising the temperature too rapidly. When about 75 per cent. of the leaf surface has yellowed the fixing of colour is begun by raising the temperature to 100° F. and also raising the top ventilator over the ridge of the roof about half the length of its travel. The temperature should be maintained at 100° F. till the whole surface of the leaf has yellowed, with only a trace of green along the veins and mid-ribs and then the temperature should be increased at the following rates :—

102½° F. for one hour, top ventilators full open, bottom ventilators quarter open.

105 ° F. for one hour, top ventilators full open, bottom ventilators half open.

107½° F. for one hour, all ventilators full open.
110° F. do.
112½° F. do.
115° F. do.
117½° F. do.
120° F. do.
122½° F. do.
125° F. for four hours, all ventilators full open.

2——J. N. A 2684 (3/41)

The fixing of colour therefore takes from 13 to 16 hours at a temperature ranging from 100° to 125° F. The best colour in tobacco is usually obtained when the leaf is fixed with a very faint greenish tinge which disappears during the subsequent fermentation in bulk. Sponging is the term given to the reddening of the leaf caused by excessive moisture during the late stage of yellowing and at the commencement of the fixing stage. This can be prevented by opening the ventilators : the correct manipulation of the top and the bottom ventilators is just as important as the maintenance of the correct temperature if good colour is to be obtained. If difficulty is experienced in reducing the moisture sufficiently, the temperature in the barn may be " flashed " that is raised quickly from 112 to 120° F. and after about half an hour allowed to drop back to 110° F. One or two such flashes are usually sufficient to dry out the excessive moisture. This is done to prevent the sponging of the leaf owing to the presence of too much moisture. The temperature is held at 125° F. for four hours to accustom the leaves to a high temperature. During the process of fixing the colour temperature should be kept constant.

DRYING THE LEAF

The web of the leaf should be thoroughly dried out at a temperature of 130 to 140° F. and during this stage the temperature is raised by 5° F. every two or three hours. The temperature should be maintained at 140° F. till the web of leaf is thoroughly dried.

The remainder of the process consists of drying the mid-ribs of leaves. This requires 36 to 40 hours with a temperature ranging from 145° to 160° F. During this stage the temperature is raised by 5° F. every other hour and maintained at 160° F. till the mid-ribs are thoroughly dried. The top and the bottom ventilation should be reduced at this stage, allowing slightly more ventilation at the top than at the bottom. It is not advisable to raise the temperature above 160° F. because the leaf becomes brittle and it loses the soft silkiness and the bright colour desired in high grade tobacco. After the mid-ribs are dried, the fire is raked out, doors and ventilators are left open for the barn to cool.

It is difficult to lay down a definite formula, as the methods of curing are subjected to modifications due to different stages of maturity, variable texture of leaf, climatic conditions and other factors. Higher temperatures are required in wet weather than in dry weather, and lower temperatures are required in cool weather than in warm weather.

A curing chart of a fairly even barn load of tobacco is appended.

CURING CHART

Date.	No. of Hours.	Temp. F.	Relative Humidity.	Raising of Temp.	Time.	Remarks.
16.2.37	1	80°	82		5 P.M.	Loaded barn and started firing
	2	80°	82		6 ,,	
	3	80°	82		7 ,,	
	4	85°	82	85°	8 ,,	
	5	85°	82		9 ,,	
	6	85°	82		10 ,,	
	7	85°	82		11 ,,	
	8	85°	82		12 (midnight)	
17.2.37	9	85°	82		1 A.M.	
	10	87½°	85	87½°	2 ,,	
	11	87½°	85		3 ,,	
	12	87½°	85		4 ,,	
	13	87½°	85		5 ,,	
	14	87½°	85		6 ,,	
	15	90	80	90°	7 ,,	Slight change in colour. Placed wet gunnies over flue-pipes to maintain high humidity
	16	90	80		8 ,,	
	17	90	80		9 ,,	
	18	90	80		10 ,,	There was high wind. Continued placing of wet gunnies
	19	90	80		11 ,,	Colour improving
	20	90	80		12 (noon)	
	21	92½°	80	92½°	1 P.M.	Colour improving, high wind. Continued placing of wet gunnies
	22	92½°	80		2 ,,	
	23	92½°	80		3 ,,	
	24	95°	80	95°	4 ,,	Considerable change in colour. High wind retarding yellowing of leaves. Colour now spreading
	25	95°	80		5 ,,	
	26	95°	80		6 ,,	
	27	95°	80		7 ,,	
	28	95°	80		8 ,,	
	29	97½°	79	97½°	9 ,,	Continued placing of wet gunnies, colour very much changed, not ready yet for fixing

Date.	No. of Hours.	Temp. F.	Relative Humidity.	Raising of Temp.	Time.	Remarks.
17.2.37 ..	30	97½°	79		10 P.M.	
	31	97½°	79		11 „	
	32	97½°	79		12 (midnight)	
18.2.37 ..	33	97½°	79		1 A.M.	Colour very much changed, will be ready for fixing soon, removed wet gunnies
	34	97½°	79		2 „	
	35	100°	60	100°	3 „	Top ventilator half open, commenced fixing colour
	36	100°	60		4 „	
	37	100°	60		5 „	
	38	102½°	42	102½°	6 „	Top ventilator full open, and bottom ventilators quarter open
	39	105°	41	105°	7 „	Top ventilator full open and, bottom ventilator half open
	40	107½°	40	107½°	8 „	All ventilators full open
	41	110°	40	110°	9 „	All ventilators full open
	42	112½°	40	112½°	10 „	
	43	115°	38	115°	11 „	
	44	117½°	37	117½°	12 (noon)	
	45	120°	35	120°	1 P.M.	
	46	122½°	35	122½°	2 „	
	47	125°	32	125°	3 „	
	48	125°		125°	4 „	Humidity not recorded
	49	125°		125°	5 „	
	50	125°		125°	6 „	
	51	130°		130°	7 „	
	52	130°		130°	8 „	
	53	130°		130°	9 „	
	54	135°		135°	10 „	
	55	135°		135°	11 „	
	56	135°		135°	12 (midnight)	
19.2.37 ..	57	140°		140°	1 A.M.	
	58	140°		140°	2 „	
	59	140°		140°	3 „	
	60	140°		140°	4 „	
	61	145°		145°	5 „	Bottom ventilators quarter closed
	62	145°		145°	6 „	

Date.	No. of Hours.	Temp. F.	Relative Humidity.	Raising of Temp.	Time.	Remarks.
19.2.37 ..	63	.. 150° ..	..	.. 150° ..	7 a.m.	.. Bottom ventilators half closed
	64	.. 150° ..	..	.. 150° ..	8 ,,	
	65	.. 155° ..	..	.. 155° ..	9 ,,	.. Bottom ventilators full closed. Top-ventilator half closed
	66	.. 155° ..	..	.. 155° ..	10 ,,	
	67	.. 160° ..	..	.. 160° ..	11 ,,	
	68	.. 160° ..	..	.. 160° ..	12 (noon)	
	69	.. 160° ..	..	.. 160° ..	1 P.M.	
	70	.. 160° ..	..	.. 160° ..	2 ,,	
	71	.. 160° ..	..	.. 160° ..	3 ,,	
	72	.. 160° ..	..	.. 160° ..	4 ,,	
	73	.. 160° ..	..	.. 160° ..	5 ,,	
	74	.. 160° ..	..	.. 160° ..	6 ,,	
	75	.. 160° ..	..	.. 160° ..	7 ,,	
	76	.. 160° ..	..	.. 160° ..	8 ,,	
	77	.. 160° ..	..	.. 160° ..	9 ,,	
	78	.. 160° ..	..	.. 160° ..	10 ,,	
	79	.. 160° ..	..	.. 160° ..	11 ,,	
	80	.. 160° ..	..	.. 160° ..	12 (midnight)	
20.2.37 ..	81	.. 160° ..	..	.. 160° ..	1 A.M.	
	82	.. 160° ..	..	.. 160° ..	2 ,,	
	83	.. 160° ..	..	.. 160° ..	3 ,,	
	84	.. 160° ..	..	.. 160° ..	4 ,,	
	85	.. 160° ..	..	.. 160° ..	5 ,,	
	86	.. 160° ..	..	.. 160° ..	6 ,,	
	87	.. 160° ..	..	.. 160° ..	7 ,,	
	88	.. 160° ..	..	.. 160° ..	8 ,,	
	89	.. 160° ..	..	.. 160° ..	9 ,,	
	90	.. 160° ..	..	.. 160° ..	10 ,,	
	91	.. 160° ..	..	.. 160° ..	11 ,,	
	92	.. 160° ..	..	.. 160° ..	12 (noon)	
	93	.. 160° ..	..	.. 160° ..	1 P.M.	
	94	.. 160° ..	..	.. 160° ..	2 ,,	
	95	.. 160° ..	..	.. 160° ..	3 ,,	
	96	.. 160° ..	..	.. 160° ..	4 ,,	.. Raked out fire, and allowed barn to cool

SHINGLING

Shingling is the arrangement of the sticks of tobacco when unloaded from the barn. When leaves are soft enough for handling, they are removed from the barn and shingled, *i.e.*, sticks are stacked on mats or cadjans so that the next upper stick overlaps the leaves of the lower by one-third of their length. These sticks when shingled will form a heap of about four square feet and the heap is covered with clean gunnies or mats. Under favourable weather conditions the leaves can be detached from the sticks the next day. If rains prevail the heap is kept till dry weather comes.

GRADING

The cured tobacco should be in the right condition for grading, *i.e.*, it should be slightly flaccid so that it will not break in handling, but it should not be too moist nor too soft, because it will then turn mouldy and lose the bright colour. A bundle of leaves when held by the butts, shaken about and held with the tips of the leaves upwards, should if in the right condition for handling remain erect or only slightly drooping.

The grading of tobacco should best be done on the farm. Grading does two things. It allows your tobacco to show up in the best light, and it also gives both the grower and the prospective buyer a much more correct idea of the percentages of all the grades. In cigarette tobacco, colour is the base for grading. Sub-grades are formed from leaves of the same colour, but of indifferent quality. The following are the recognized grades of cigarette tobacco :—

1. Bright lemon coloured leaf.
2. Bright orange coloured leaf, not so clear as No. 1. This grade will take slight sponging or blotching, but should show good colour.
3. This grade should carry leaf with a fair amount of good colour, but not good enough for Nos. 1 and 2 and should carry a trace of green.
4. This grade is bright green, leaf should be free of serious sponging and if kept in proper condition will improve colour and the same will go into grades 1 and 2. If kept in bad condition will become worse and go to lower grades. Here conditioning is very important.
5. This grade will carry all leaves which will not make any of the above grades. It will show very little colour and will carry sponge and dark leaves, but the leaves should be alive. Dead or perished leaves which have no stretch will be discarded.
6. If harvesting and curing is properly done this grade should not appear. Dark brown and green leaves which are unsuitable for cigarette making are put here.

BULKING

After grading the leaves of each grade are made into small bundles or hands containing 25 leaves depending on size. These are bound and held together by a leaf of the same grade. Various grades should be kept separately in single bulk, the division being maintained by a single string or straw. The hands are bulked on platforms to a height of about 4 feet. The heaps are covered with clean gunny bags or mats. The bulks should be broken up once in fourteen days and rebulked so that the upper hands will go to the bottom of the bulk.

Prior to transport each grade is packed separately with the aid of a baling press into bales of convenient sizes for handling. A good size baling press should be 24 in. by 34 in. (base to be 18 in. deep) and should not weigh more than 150 lb. Bales should be wrapped in dry gunnies or mats to prevent drying out and damage by handling. The leaf should be sufficiently damp to be pliable but not to break in handling ; on the other hand the leaf should not be wet or too soft. If the leaf becomes too soft it should be dried up by hanging out in a shade exposed to wind and air till sufficient moisture goes out of the leaf to leave it in a proper condition for bulking. If a number of leaves are gathered together with the butt ends in one's hand and the leaves are shaken out and held upright, and if these leaves remain more or less erect or upright, the tobacco is satisfactory in keeping condition. If the leaves droop like the leaves of a palm they are unsafe for bulking.

RECENTLY INTRODUCED FOOD CROPS AT THE EXPERIMENT STATION, PERADENIYA
II—PENNISETUM MILLET

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THIS is known also as pearl millet, bulrush millet, or spiked millet. In Ceylon it is generally known by the South Indian name *cambu*. In India pennisetum millet stands only next to sorghum in importance and occupies an area of about eighteen million acres every year distributed practically all over India except in very wet parts such as Konkan and Assam. Pennisetum millet, being more drought resistant than sorghum, has a greater degree of adaptability to adverse conditions than sorghum. Unlike sorghum it tillers freely. A crop grown for grain, it yields along with grain a fairly large amount of fodder which amounts to as much as 2½ to 3 times the yield of grain. The fodder of pennisetum millet being relatively more fibrous is considered slightly inferior to that of sorghum. It is, however, as good as paddy straw. Pennisetum millet generally occupies lighter types of soils under relatively dry conditions where other cereal crops cannot grow satisfactorily. Its adaptability to adverse conditions and high yield of straw along with grain has won for it the front rank among the small-grained millet crops in India.

VARIETIES

There are a large number of varieties growing in India suitable for a wide range of conditions. In Ceylon this crop is cultivated to a small extent in the Jaffna Peninsula; but the variety grown there has a very small-sized earhead with a small-sized grain and is a very poor yielder. The problem was, therefore, to introduce a high-yielding and vigorously-growing variety which can successfully withstand comparatively heavy showers

of rain which commonly occur even under the dry zone conditions in Ceylon. Jamnagar, an Indian State situated in the north-western part of Kathiawar, Gujarat, Western India, is famous for the well-known giant variety of this crop. The seed of the Jamnagar Giant variety was, therefore, obtained for trial. It was first grown at the Experiment Station, Peradeniya, on a small trial plot during the south-west monsoon of 1938. This small scale trial appeared quite promising. Since then it has been grown every season at the Experiment Station, Peradeniya, with remarkable success. After its preliminary success at the Experiment Station, Peradeniya, it has also been introduced at many departmental experiment stations in the dry zone and has given good results under favourable conditions. This variety has now been acclimatized under local conditions.

The characteristic features of this variety are : very large-sized earhead 1½ to 3 feet in length, with large-sized, bright, pearl-like grain and profuse tillering. Another point in favour of this variety is that it can tolerate comparatively high rainfall conditions, provided actual stagnation of water does not take place. It can resist drought to a remarkable extent. In fact, in some of the seasons of severe drought this was one of the few crops that looked green and succeeded at the Experiment Station, Peradeniya. From the observations made on the standing crop at various stages of its growth, the crop appeared to have excellent green luxuriant growth and heavy tillering almost similar to the crop in parts of Kathiawar and Gujarat. It is interesting to note that the remarkable size of its earhead has been maintained during the course of its cultivation in this country and has been an object of considerable attraction both at the Experiment Station, Peradeniya, and in the dry zone areas where it has been introduced. This variety is ready for harvest under the local conditions after four months of sowing.

SOIL REQUIREMENTS

This crop requires lighter types of soils where sorghum may not grow satisfactorily. Even some of the gravelly soils have been found satisfactory for this crop. This crop can, therefore, be grown on chenas in the dry zone and generally on any type of high land where the soil is not heavy.

CLIMATIC REQUIREMENTS

The crop does best when the climate is moderately dry and when rain comes in light showers with plenty of sunshine between the showers. If there is heavy early rain, poor germination and stunted seedlings are noticed. With continuous rainfall, plants turn pale yellow and the pollen is washed away. Generally the crop cannot stand heavy rain. In certain places

where the early rains are heavy the sowing has to be purposely delayed for about a month to avoid the risk of damage from rain during the very early stage. This is essentially a dry zone crop and should be raised in areas where the rainfall is low. During the growing period the rainfall should be light and frequent. The flowering period as well as the harvesting period should preferably be free from cloudy weather or rain. Rain during the flowering period washes away the pollen and interferes with the fertilization and the result is that the earheads are almost blank, *i.e.*, without the formation of grain. Rain during the ripening of grain discolours the grain by moulds and sometimes brings about serious lodging of the plants. It can be grown satisfactorily up to an elevation of 3,000 feet.

SUITABLE SEASON

Over a large part of the dry zone this is a suitable cereal crop for the south-west monsoon season and should be grown in rotation with other crops. In the moderately-wet mid-country zones, it may be grown during the north-east monsoon so that the crop may ripen during the dry month of February. It can also be cultivated during the *yala* season on certain paddy lands under village tanks where the soil is light and well drained, during years when the available supply of water is not considered sufficient for the growing of the paddy crop.

METHODS OF CULTIVATION

The preparatory cultivation consists of light and shallow ploughing followed by harrowing. Sometimes the land may not be ploughed at all and only harrowing fulfills the requirements of the preparatory tillage. The root system being entirely a surface feeder, deep cultivation is not necessary.

The spacing of $1\frac{1}{2}$ feet $\times$ 1 foot for the Jamnagar Giant variety has been found suitable under local conditions. The crop can, therefore, be sown by a three-coultered drill if available, or it can be sown by dibbling in rows previously marked out to a spacing of $1\frac{1}{2}$ feet. Three to four seeds should be dibbled to a depth of about an inch in each hill. The seed rate per acre under these conditions of sowing as an entire crop usually ranges from 4 to 6 pounds. The land should be planked over after sowing to cover the seed. In India, the smaller varieties of this crop are grown as mixed crop with dhal, horse gram, green gram, cowpeas or gingelly.

In some parts of India, when the seedlings are just about three inches, a small wooden plank is rolled over the crop with a view to encourage tillering. Thinning and filling up of vacancies should be attended to as soon as possible after a fortnight of sowing. Not more than two plants should be allowed to grow on each hill. When the crop is about six inches

high the first inter-cultivation should be given. The second inter-cultivation, if necessary, can be given when the plants are about 18 inches high. Wherever there is a possibility of lodging of plants, the crop requires to be earthed up soon after the last inter-cultivation. This gives additional support to the plant and its tillers. The crop is ready for harvest after four months of sowing.

Generally a mixed crop of this millet is not given any manure though it appears to respond to the application of manure. If it is not rotated with a leguminous crop, the crop would benefit by the application of about five tons of cattle manure or compost during the course of the preparatory tillage. As for the application of artificial fertilizers, one of the authors found nitrate of soda to be useful under Poona conditions when applied as a top-dressing at the rate of 20 lb. nitrogen per acre after about three weeks of sowing.

The crop requires to be watched against birds in the same manner as sorghum from the time the earheads begin to be filled up with grain. It is necessary for a period of five to six weeks.

This variety matures unevenly on account of a large number of tillers. Under local conditions there is the possibility of untimely rains. To counteract this difficulty, the crop is harvested in two or three instalments as and when the earheads get ready for harvest. After the earheads are removed, the stems may be cut close to the ground and used for fodder or for hay making. The earheads are allowed to dry under the sun. The grain is separated by threshing either under the feet of bullocks or by beating with wooden flails. The seed can then be cleaned by the usual winnowing.

YIELDS

In India the yield of grain of this variety under ordinary conditions ranges from 900 lb. to 1,200 lb. per acre. On fairly-good land and with good cultivation the yield ranges from 1,200 lb. to 1,800 lb. per acre. Yields comparable to Indian standards have been obtained at the Experiment Station, Peradeniya. The crop is known to respond to good cultivation and manuring. This may be illustrated by an example of the crop grown during the south-west monsoon season of 1940 at the Experiment Station, Peradeniya. The crop in this season received 50 cartloads of compost during the course of the preparatory tillage and as a result yielded as high as $39\frac{3}{4}$ bushels or 2,226 lb. grain per acre. A bushel of grain weighs 56 lb.

PESTS AND DISEASES

The most common disease with this crop in India is known as " green ear " disease. This is caused by a fungus organism

known as *Sclerospora graminicola*. The disease appears in the form of a mass of small, twisted green leaves instead of the grain in the earhead or instead of the entire earhead. The disease may affect a part or the entire earhead. In very severe cases, only a cluster of small leaves may appear in the place of the earhead. This disease has also been observed in a few scattered cases on the crop grown at the Experiment Station, Peradeniya, in certain seasons associated with continuous rain. No insect pests are known to damage this crop seriously.

METHODS OF USING AS FOOD

The grain is chiefly used in the form of flour. Thicker types of *chapathis* or *roti* can be made from the flour of this grain. In India the grain is also used as popped corn after parching or roasting on a popper. The tender earheads when the grain is just in milk stage are parched and eaten by the villagers as a delicacy. The grain of this millet on analysis is found to contain 11·59 per cent. protein, 4·99 per cent. fat and 2·65 per cent. mineral matter which clearly shows that pennisetum millet is definitely better than rice or kurakkan and almost equal to wheat in food value.

THE PADDY PENTATOMID BUG *SCOTINOPHARA (PODOPS) LURIDA* BURM.

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THIS insect is common in China and Japan where it is an occasional pest of paddy. It is also present in Assam and India where, however, it is regarded as a rare species. A related species, *Scotinophara coarctata* F., is recorded by Dammerman as a rice pest in the Malay Archipelago. In Ceylon it has been recorded from time to time chiefly from the southern-most parts of the Island but hitherto not in numbers large enough to be considered as a pest. The places it has been recorded from in Ceylon are Matara, Bentota, Hambantota, Ambalantota, Anuradhapura, Dandagamuwa, Kurunegala, and Ja-ela. During the Maha of 1940, however, it occurred in very large numbers in the paddy areas of the Walawe Left and Right Bank Schemes.

Host plants.—It is found on paddy and allied grasses but breeds chiefly on paddy. In the laboratory it has been bred successfully on Napier and Guinea grass.

DESCRIPTION AND LIFE-HISTORY

This insect belongs to the family of bugs (*Hemiptera-Heteroptera*) known as the shield bugs (*Pentatomidae*), which are characterized by the well-developed dorsal thoracic shield which projects posteriorly covering and protecting the abdomen. The adult bug is a dull coloured dark-brownish insect (fig. 1) 9 to 10½mm. long and about 5 to 5½ mm. broad and of a broadly ovate shape. The head is slightly convex and sinuate in front of the eyes. The antennae are about half the length of the body, 6-segmented, with the broad basal joint concealed when viewed from above, second joint distinctly shorter than third, and terminal joint slightly thicker than the rest of the antenna. The 4-jointed rostrum reaches the posterior coxae. Two ocelli lateral in position are present. The thorax is almost black in colour with a coarsely punctate surface. The pronotum has straight lateral margins, with a distinct spine near each anterior angle. The scutellum is narrowed behind the base, that is, in the section covering the abdomen and extends backwards almost to the apex of the abdomen. The coxa and femur of the legs are black in colour while the remaining segments are brown. The tarsi are three jointed. The under

surface of the bug is also black in colour becoming brownish towards the margin. Both sexes are similar in appearance except in the postero-ventral region of abdomen where the secondary-sexual differences are visible.

Life-History : Eggs. –These are deposited in a regular manner in commonly two, sometimes three, very rarely four, parallel rows each egg being placed in the alternate space between the eggs of the adjoining row. The maximum number of eggs found to be laid in a single row is 13. Each egg is about 1 mm. long and $\frac{3}{4}$ mm. broad, cylindrical in shape and pale green in colour when freshly laid. As development proceeds they turn pinkish. They hatch in 5–6 days (fig. 2). *Nymphs. First instar* (fig. 3). The newly hatched nymph is about 1 mm. in size and almost circular in shape ; the head and thorax are dark brown in colour and finely punctured ; eyes are black and prominent ; antennae and legs are pale brown, abdomen slightly darker and finely dotted with black ; the mid-dorsal abdominal region carries three dark brown transverse bands, the first of which is very narrow. This instar lasts for 5–6 days. *Second instar.* This is about $2\frac{1}{2}$ mm. long. Head and thorax yellowish brown and finely punctured with black ; eyes are reddish brown and prominent ; four irregular brownish markings are present on either side of the pro-and meso-thorax ; antennae and legs are pale yellowish brown ; abdomen darker brown with fine punctures and transverse bands as in first instar. Duration of the instar is 11–13 days. *Third instar* (fig. 4). This is about $3\frac{1}{2}$ mm. long ; head and thorax as in previous instar ; antennae pale brown with dark brown terminal segments ; legs pale yellowish brown ; abdomen pinkish brown dotted with black. Mid-dorsal transverse bands as in previous instars. Duration of instar is 8 to 11 days. *Fourth instar.* This is about 5 mm. long. Head and thorax as in previous instar ; antennae, legs and abdomen similar to previous instar. Duration of the instar 9 to 10 days. *Fifth instar* (fig. 5). About 8 mm. in size with brown head and thorax ; wing pads distinct ; antennae pale yellowish-brown except terminal segment which is dark brown. Abdomen dark brown with fine black punctures with transverse bands as in previous instar. It lasts for 11 to 13 days. The total life cycle period from egg to adult occupies 49 to 59 days or nearly 2 months.

HABITS AND NATURE OF DAMAGE CAUSED

Both the nymphs and adults feed entirely on the stems of the paddy plants, inserting their slender beaks into the tender portions of the stem and sucking its juices. They are generally active during the late evenings and early mornings. They avoid strong sun light and during the day they cluster near the bases of the plants almost at the water level, and if no water

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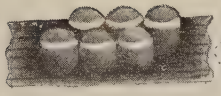

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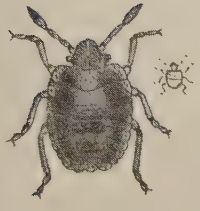

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G.L. de S.
Mar. 1941

Block by Survey Dept.

THE PADDY PENTATOMID BUG—*Scotinophara* (*Podops*) *lurida* Burm.

Fig. 1—Adult bug, × 5.
Fig. 2—Egg-mass, × 5.
Fig. 3—First instar, nymph, × 10.
Fig. 4—Third instar, nymph, × 5.
Fig. 5—Fifth instar nymph, × 5.
Fig. 6—Adult parasite, × 20.
Fig. 7—Parasitized egg-mass, × 5.

is present in the field they pass down into the cracks in the soil of the fields as well as bunds. The adult bugs after emergence spend a few weeks on the plants feeding occasionally until harvesting time when they retire to their hiding places in the soil in the fields as well as in the adjoining patches of high land and surrounding jungle. Here they remain in inactive retirement till the emergence of the paddy plants of the next season. As soon as the new paddy is about 3 weeks old they invade the paddy again. They do not, however, feed to any appreciable extent and are at first relatively inactive during the day. During the night they generally leave the paddy temporarily and fly about settling down again in the morning. After a few days of such activity, mating and egg laying take place after which the adults gradually die off. The damage inflicted by these insects is caused by the puncturing of the stems and extraction of the sap. If the bugs are few in number there is no appreciable damage done to the plants, but if numerous the vitality of the plants is seriously affected and the plants may be even killed outright. This is particularly so if the plants are attacked during the first two months of growth. Subsequent to this they are capable of resisting the attack even if severe.

CONTROL MEASURES

The most effective and practicable control measures for a pest of this sort are those cultural practices associated with good paddy cultivation. They are as follows :—(1) Cleaning up the bunds, the adjoining lands, and the surrounding jungle of weeds and wild grasses either by keeping them regularly cut or by burning. (2) Erecting strong and high bunds. (3) Ploughing-in the stubble of the harvest. These measures will destroy large numbers of the adult bugs in their hiding places before the appearance of the paddy plants. If the pest is prevalent in the district, however, further remedial measures must be taken. This consists of (1) carefully watching the young paddy from the 3rd to the 6th week of growth and, if the pest appears, flooding the fields thus drowning the pest. The nymphal stages of the pest are particularly susceptible to this treatment. In order to improve and quicken the effect of flooding, oiling of the flooded fields may be done by using a little kerosene oil. This must be introduced into the inflowing water and thoroughly distributed. The oiled water must be run off after 3–6 hours and the fields subsequently flooded with fresh water so as to wash off the oil completely. (2) Collecting the pest by hand and destroying it. This can be most conveniently done during the 5th or 6th week of growth when the normal weeding of the fields is carried out. The bugs as they are picked may be put into a vessel containing water with a film of kerosene floating

on top. The removal of weeds makes flooding more effective in destroying the pest and also makes the paddy plants more vigorous and capable of withstanding the attack of the bugs.

Another possible control measure is the growing of a small area of paddy a few weeks ahead of the remaining paddy as a trap crop. The pest would be attracted to this from their places of retirement and can be dealt with before the main paddy appears.

The natural enemies of the pest consist of a few predaceous bugs and a Hymenopterous wasp (fig. 6). The former attack and feed on the young nymphs but they are very scarce and their controlling effect quite negligible. The latter parasitizes the eggs of the bug. Eggs 1–3 days old are susceptible to attack. A single parasite egg is laid in each host egg and the parasitized eggs turn a purplish hue as development of the parasite goes on (fig. 7). This is completed in 11 days after which the parasite emerges through an irregular hole which it makes in the cap of the egg. Records taken in the field during the Maha of 1940 give an average parasitism of 89 per cent. This parasite therefore seems capable of effecting quite an appreciable control of the pest under normal conditions.

ACKNOWLEDGEMENT

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THE RELATIVE RESISTANCE OF SOME COWPEA VARIETIES TO *AGROMYZA PHASEOLI* COQ.

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THE bean fly (*Agromyza phaseoli* Coq.) is a troublesome pest of cowpeas in Ceylon. Though not so damaging as in beans, the pest is nevertheless responsible for numerous casualties and for considerably reduced yields in cowpeas.

The adult fly deposits its eggs within the leaves soon after the seedlings have appeared above ground. The larvae, when they hatch out, burrow down the petiole and stem, and eventually pupate at ground level. Infested plants wilt and may subsequently die. The plants often exhibit characteristic lesions near the collar where the stem is ruptured by the crowding of larvae and pupae. The hilling up of affected seedlings and the consequent development of adventitious roots at points above these lesions may induce recovery. Infested plants, even if they survive, may however, remain unthrifty.

The pest can be effectively checked by the frequent application of contact insecticides. Elaborate spray schedules, however, entail considerable and recurrent expenditure, and demand skilled supervision, and cannot hence be unreservedly recommended to the village grower.

The search for bean-fly-resistant cowpeas has been attended with some degree of success. Records of bean fly damage made in variety trials set down at the Experiment Station, Peradeniya, in the *yala* season, 1940, demonstrated significant differences in resistance between cowpea varieties, and are presented in this contribution.

EXPERIMENTAL MATERIAL AND METHODS

Varieties of Cowpea.—The performance of 93 varieties of cowpea collected from various parts of the Island had been investigated at Peradeniya during the period 1933–40. In

yala 1940, three of the most prolific of these varieties, *viz.*, 18aa buff, V4 and 6, were selected for further trial. Summary descriptions of these three varieties are presented in Table I.

Design of Experiment.—The appearance in *yala* 1940, of a severe epiphytotic of bean fly created conditions ideal for susceptibility tests. The tests were superimposed on an investigation of the effect of staking on the yield of the three varieties, 18aa buff, V4 and 6 (Fernando and Fernando, 1941). For the purposes of the present records, staking was considered a dummy treatment. The three varieties were replicated five times in 3/38-acre blocks. The plants were spaced 2 by 2 ft.

The Experimental Area.—The soil was a heavy loam with a pH value of 6–6·5, and had carried a crop of sorghum in *maha* 1939–40.

Planting details. –The land has been ploughed, harrowed and levelled in the usual way. Three seeds were dibbled per hill on May 28. The percentage germination in 18aa buff and V4 was over 90. The stand in 6 was rather poorer. Blanks were supplied on June 7.

RESULTS

Records made on June 21, of percentages of plants in the three varieties attacked by bean fly are given in Table 2. The analysis of variance of these data transformed to the appropriate inverse sine scale ($\theta = \mathrm{Sin}\sqrt{p}$) is given in Table 3. The variance ratio for varieties surpasses the 0·1 per cent. point, and hence indicates a very high degree of significance. Examination of the variety means given at the foot of Table III. reveals the significant superiority of 18aa buff to the other varieties. V4 and 6 do not differ significantly in susceptibility from one another.

The resistance of 18aa buff to bean fly is of especial interest in view of its other virtues which include *inter alia* a significantly higher yielding capacity than either V4 or 6, and a significantly shorter age than 6 (Fernando and Fernando, 1941).

SUMMARY

In susceptibility tests set down at the Experiment Station Peradeniya, in the yala season, 1940, the variety 19aa buff exhibited a significantly higher degree of resistance to attack by the bean fly than either V4 or 6.

ACKNOWLEDGEMENT

The writer is indebted to Dr. J. C. Haigh, Botanist, for valuable advice.

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TABLE I

Description of Cowpea varieties

Variety	18aa buff	V4	6
Vernacular name	Digali-me	Polon-me	Sangu-vellai pai-thangai
Type	Cowpea	Cowpea	Cowpea
Habit	Procumbent	Low, half-bushy	Prostrate
Leaves	Persistent	Persistent	Shed
Colour of stem	green with some purple pigment	green	green with some purple pigment
Colour of leaf stalk	do.	do.	do.
Colour of leaf	do.	do.	green
Colour of young pod	green	light green with purplish streak	light green
Colour of mature pod	brown	straw with purple blotches	pale straw
Colour of flower	violet	violet	violet
Pod habit	horizontal	horizontal	horizontal
Pod characters :			
Length	7·1 in.	7·7 in.	7·7 in.
Depth/breadth	0·8	0·56	0·73
Inflated or fully filled	inflated	fully filled	fully filled
Straight, curved or coiled	curved	—	curved
Average No. of seeds per pod	13	15	15
Seed closely or loosely packed	closely packed	closely packed	closely packed
Shape and length of seeds	subreniform 8·1 +0·06 mm.	subreniform 8·5 +0·06 mm.	subreniform 8·4 +0·04 mm.
Colour of seeds	burnt sienna	black with occasional maroon or brown spots	burnt sienna
Locality	Koslanda	Peradeniya	Jaffna

TABLE II

Percentages of Plants attacked by bean fly

Block	Variety		
	18aa buff	V4	6
I	23·4 per cent.	27·5 per cent.	58·5 per cent.
II	39·5	80·2	78·3
III	42·9	78·8	69·7
IV	14·3	54·8	53·8
V	22·7	49·0	60·3

TABLE III

Analysis of Variance of transformed data ($\theta = \text{Sin} \sqrt[4]{p}$)

	DF	SS	MS	VR	0·1 per cent. point
Stocks	4	852·33	213·08		
Varieties	2	1,336·68	668·34	20·97	18·49
Error	8	254·93	31·87		
Total	14	2,443·94			

Summary of Results

	Variety			S.E.
	18aa buff	V4	6	
Degrees ($\theta = \text{Sin} \sqrt[4]{p}$)	31·9	50·0	53·4	± 2·52
Percentages	28·0	58·7	64·5	

SELECTED ARTICLES

HOW DOES COMPOST WORK*

[*In a letter addressed to* The Countryside, *January, 1941,* "Farmer" *raises the question of how compost exerts its beneficial effect on crops, and suggests that this is largely due to its nitrogen content, and he therefore inquires concerning the cheapest form of the latter available to farmers.*]

DESPITE the vast amount of research which has been focussed in recent years on the investigation of the composition and action of humus in the soil, and compost is essentially a form of humus, it is not possible for any one to answer categorically "Farmer's" queries, but the matter is discussed in this article from the point of view of the farmer and it is hoped that these very brief notes on an extremely complex subject may be of assistance to him.

It can be said at once that compost does not merely supply nitrogen to the crop, but potash and phosphate also, and in quantities which are very considerable at the ordinary rates of application of this manure, namely, five to ten tons per acre. Moreover, these plant foods are in a readily available condition in properly made compost.

A normal well-made compost in Southern Rhodesia may be expected to contain approximately 0·8 per cent. of nitrogen, 0·4 per cent. of phosphoric oxide, 1·0 per cent. of potash, and 1·9 per cent. of calcium oxide (lime). When a dressing of 10 cubic yards (approximately 5 tons) per acre is applied to the soil, therefore, the equivalent of about 400 lb. sulphate of ammonia, of 200 lb. of 20 per cent. superphosphate, of 206 lb. of sulphate of potash, and of 190 lb. of calcium oxide or approximately 350 lb. of ground limestone, is added. It will be seen therefore that compost is a complete fertilizer, although it is an unbalanced one for most of our farm crops, with the possible exception of some vegetables, since it is lacking in phosphate (compared with the nitrogen), which is still the principal plant food in which practically all our soils are very deficient, and it supplies comparatively large quantities of nitrogen to the soil. The actual nitrogen added to the soil in the compost is not the end of the story, however, since the organic matter, the lime and the phosphate in the compost all stimulate the activity of the free-living nitrogen-fixing bacteria in the soil, and these make further considerable quantities of nitrogen (obtained from the air) available to the crop.

There is no doubt that the main effect of an application of compost on, say, a crop of maize, *which is observable to the eye,* is the effect of the large nitrogen supply which is seen in the greatly increased growth of leaf and stem. This

* By S. D. Timson, Assistant Agriculturist, in *The Rhodesia Agricultural Journal* Vol. XXXVIII., No. 3, March, 1941.

is to be expected from the analysis, of course, and from what we know by observation of the effect of a dressing of well-rotted kraal manure under favourable conditions, though the nitrogen in the latter is not so readily available as that in compost. However, the analysis shows that large quantities of phosphate and potash are also supplied by compost in a readily available form, and these will affect the growth of the crop and tend to counter-balance the tendency to an excess of nitrogen where large dressings of compost are applied. Evidence of this has repeatedly been seen in the past two or three years on farms where dressings of compost of from 7 to 14 tons per acre have been applied to maize without any additional phosphate or potash. Good yields of grain have been obtained despite the excess of nitrogen, and this could not be expected if dressings of nitrogen alone in the form of, say, sulphate of ammonia equivalent in quantity to the nitrogen in the compost had been applied without any phosphate or potash to balance it.

There is little doubt, however, that better yields of maize would have been obtained in these cases by the application of additional supplies of phosphate in the form of a suitable fertilizer, and perhaps (especially in the case of sandy soils) by additional supplies of potash, though this is unlikely, since the quantity contained in compost is large, as shown above.

Farmers can therefore be recommended to reinforce their dressings of compost applied to crops, by dressings of a suitable phosphatic fertilizer, on soils known to respond to phosphatic fertilizers. Experience on farms indicates that the normal dressing of phosphatic fertilizer can be economically reduced, where 5 to 8 tons of compost per acre are applied, but each farmer should test this for himself on his own fields. It is suggested that he should try reducing his dressing of phosphate to two-thirds, and then to a half of the normal one, and note the results.

That the effect of dressings of compost to crops is not due solely to the nitrogen it contains is indicated by the experiments of Jackson and Wad, where compost containing 110·2 lb. of nitrogen was compared with sulphate of ammonia containing the same quantity of nitrogen, in its effect on the wheat crop. The wheat treated with compost yielded 1,829 lb. of grain and 2,117 lb. of straw per acre, whereas the wheat receiving sulphate of ammonia yielded 1,210 lb. of grain and 1,472 lb. of straw per acre.

The higher yields of wheat produced by the compost are doubtless due in part to the potash, phosphate and other minerals in the compost, and also to the important effects of the humus on the bacterial population of the soil, and the improvement in the crumb-structure or friability of the soil.

Compost (as also farmyard manure), is such a complex substance and some of its reactions on the soil and plant growth are so indirect, and so dependent on varying soil and climatic conditions, that it will never be possible to reduce its beneficial effects on crops to terms of nitrogen, phosphate and potash alone.

What the farmer requires to know is whether its action in the soil can be economically reinforced by additional phosphate, potash, or nitrogen in the form of fertilizers or in any other way. As already suggested, it can be usefully

and economically reinforced with light dressings of phosphatic fertilizers, but except under exceptional circumstances it is unlikely that additional dressings of nitrogen or potash will be economic.

Now with regard to the suggestion by "Farmer" that experiments should be made to determine the cheapest way to supply a nitrogen deficiency in our soils, there can be little doubt that this can be most economically done by applying compost. On the basis of the analysis given above a 5-ton dressing per acre will supply nitrogen equivalent to 400 lb. of sulphate of ammonia. From reliable costings of making compost we can now say with assurance that a 5-ton dressing of compost should not cost more than 7*s*. 6*d*. to make, and 1*s*. 8*d*. to cart and spread on an acre of land, a total of 9*s*. 2*d*. for native labour and rations. If we neglect the phosphate and potash in the compost and charge all the cost of making and spreading it to the nitrogen, the cost of the equivalent of 400 lb. of sulphate of ammonia is 9*s*. 2*d*. spread on the land. The same dressing of nitrogen applied as sulphate of ammonia would cost in cash f.o.r. Salisbury at the pre-war price (£9 15*s*. 0*d*. per ton) approximately 39*s*. and at present prices (if it is obtainable) much more, actually £3 12*s*. 0*d*.

The green-manure crop is another cheap source of nitrogen, since the top growth of a well grown crop of sunn-hemp when ploughed under will return to the soil about 210 lb. of nitrogen per acre, or the equivalent of 1,050 lb. (approximately) of sulphate of ammonia at a cost of, say 20*s*. per acre. The nitrogen contained in the root system of the sunn-hemp is an unknown factor, but we know from research in America that in the root system of a good velvet bean crop there is about 10 lb. of nitrogen per acre, which is equivalent to about 50 lb. of sulphate of ammonia. If this figure be taken for the nitrogen in the root system (it is sufficiently near for the present purpose), we arrive at a total nitrogen content of the sunn-hemp crop of 200 lb., which is equivalent to 1,100 lb. of sulphate of ammonia. However, only two-thirds of this nitrogen (approximately) is obtained from the air through the agency of the legume bacteria, so the whole sunn-hemp crop adds only some 146 lb. of new nitrogen to the soil. This is equivalent to 733 lb. of sulphate of ammonia. There is this great difference, however, between compost and fertilizers on the one hand, and the green manure crop on the other, namely that the land under green manure is idle, in the sense that it is not producing a cash crop or one which can be converted into cash through the agency of stock.

It would appear to be fair therefore to charge to the green manure crop as a source of nitrogen the profit, which might be expected from a cash crop, which might have been grown on the land occupied by the green manure.

Land which would normally be green manured in the maize belt may be expected to produce 8 bags an acre, and the profit per bag may be taken to be 2*s*. 6*d*. Therefore the sum of 20*s*. is to be added to the cost of producing and ploughing under the sunn-hemp (20*s*. per acre) making the total cost of producing the nitrogen equivalent to 733 lb. of sulphate of ammonia at 40*s*. or approximately 21*s*. 9*d*. for nitrogen equivalent to 400 lb. of sulphate of ammonia, our basis of comparison with compost.

We finally arrive at the cost of supplying to the soil 80 lb. of nitrogen, or its approximate equivalent of 400 lb. of sulphate of ammonia, to be 9*s*. 2*d*. as compost; 21*s*. 9*d*. in the form of sunn-hemp ploughed in, and 72*s*. as sulphate of ammonia at present prices, or 39*s*. at pre-war prices of this fertilizer.

Of course, all the nitrogen in compost or in green manures is not available to crops in the year of application, since a proportion remains bound up in the humus until the following year, but we are concerned at the moment with the cheapest source of nitrogen on the farm, and it is clear from the above facts that the nitrogen in the compost and in green manures is very much cheaper than that in the cheapest artificial fertilizer source of nitrogen.

The subject has been pursued at some length as it is considered desirable once again to emphasize the fact that the nitrogen supply for the soil should be produced on the farm as far as this is possible, since it is a very expensive item to purchase in the form of fertilizer. The estimates given above illustrate in a practical form how much cheaper it is for the farmer to manufacture his own supplies of nitrogen on the farm rather than purchase it in the form of artificial fertilizer.

Of course, this is not the whole story of nitrogen supply on the farm by a long way, since there are occasions when only a nitrogenous fertilizer, alone, or, perhaps, in combination with the green manure or compost (as in the growing potatoes) can be used, particularly in the case of the tobacco crop, and in top-dressing pastures, or crops temporarily suffering from nitrogen starvation. Nevertheless, if the farmer properly maintains the nitrogen supply in his soil by green manuring, by applying compost, and by ploughing under the stubble of legumes and grass hay crops, he will seldom require to purchase nitrogenous manures for he will in those ways maintain the humus content of the soil, and it must be remembered that the humus in the soil is the source of all the nitrogen consumed by crops, except where it is added to the soil in the form of inorganic fertilizers.

It should be mentioned here that maize has not given an economical response to nitrogenous fertilizers in experiments carried out at the Salisbury Experiment Station during the seasons 1929–30 and 1930–31. In the former year nitrate of soda was applied at the rate of 75 lb. per acre and 150 lb. per acre in the drills when the seed was sown, and at 75 lb. per acre broadcast when the maize was between 6 and 7 inches high. No beneficial effect on the yield of maize was recorded.

In 1930–31 a top dressing of 100 lb. of nitrate of soda per acre was applied along the row of plants (*a*) when they were 12 to 24 inches high; (*b*) when the plants were near the flowering stage; (*c*) from the time when the maize was 12 inches high in weekly applications of 25 lb. each. The cost of 100 lb. of nitrate of soda at that time was 16*s*. (it is now 16*s*. 6*d*.). In this experiment increases in yield of maize over the control were for the three methods of application as follows—(*a*) 0·72 bags per acre; (*b*) 1·74 bags; (*c*) 1·85 bags per acre. These increases, however, were not statistically significant and may therefore have been due to chance. Even the greatest increase in yield (1·85 bags per acre) was not profitable.

In both experiments a basic dressing of 400 lb. of potassic superphosphate per acre was applied during preparation of the soil in order to ensure that a lack of either potash or phosphate should not interfere with the response of the maize to nitrogen. Furthermore, at the Potchefstroom School of Agriculture no significant response by maize to applications before planting of 100 lb. of sulphate of ammonia or of 133 lb. per acre of nitrate of soda, since the experiment was commenced in 1932, either in the form of increases in yield of grain or of stover, was shown. A basic dressing of 200 lb. per acre of superphosphate is applied annually.

With regard to "Farmer's" suggestion that the effect of the method of applying compost to the soil might affect its value, this is being investigated on the Witchweed Demonstration Farm near Whitecliffe. The indications at present are that covering the compost by ploughing is more beneficial to the maize crop than covering by disc-harrow, as evidenced by the considerably stronger growth and darker green colour of the maize, where the compost was ploughed in. Farmers are advised to try this simple experiment in order to obtain information concerning the matter under their own conditions of soil and climate.

The very important beneficial effect of compost, green manure or kraal manure, on the crumb structure or friability of the soil, since this is largely due to their humus content, must necessarily be only temporary since humus in the soil is continually being destroyed in arable land in this Colony by the action of micro-organisms. This is especially true of our soils, since the high soil temperature increases the activity of these organisms. The work of Mohr has demonstrated that humus will not accumulate in well-drained soils when the average temperature is 77° Fahrenheit or higher, as is usually the case in this Colony, during the summer months of October to April. It is probable, too, that destruction of humus in the surface soil during the winter months is furthered by other agencies, including the action of sunlight.

For these reasons the farmer in this Colony must face the necessity of continually replenishing the supply of humus in the soil by green manuring, compost, kraal manure, and the stubbles of legumes and other annual hay crops. The great efficiency of temporary grass leys in restoring the crumb structure and humus content of the soil has been demonstrated in other countries throughout the world and is under investigation here, and should be borne in mind. If the farmer maintains the humus content of his soil in these ways he will automatically maintain the nitrogen supply at the same time, since humus is the only source of nitrogen in the soil for plant growth, except where it is added in the form of inorganic fertilizers.

A good humus supply in the soil, secured by the methods indicated above, will also normally ensure a good supply of potash, but the farmer will always need to maintain the phosphate supply in the soil by the addition of phosphates, excepting only, perhaps, in the case of certain heavy black soils, on which dressings of sulphate have not proved effective in Matabeleland.

It is possible that the mycorrhizal association with the roots of our crops may prove to be an important factor in the success of compost. Roots of maize grown on land dressed with compost on the Witchweed Demonstration

Farm last season were forwarded to Sir Albert Howard, and were found by the leading authority on the subject to be thoroughly permeated with mycorrhizal hyphae. The mycorrhizal association has been proved by this Department to be essential to the successful culture of certain pine trees in this Colony.

It is also possible that part of the beneficial effect of compost may be ascribed to the action of some plant-stimulating and growth-regulating substances known as Hormones, which are akin in their action on plant growth to vitamins in the food of man, but this is not sufficiently established at present to be accepted without reserve.

Much research has been directed in recent years to the " deficiency diseases " of crops, due to the absence or deficiency in some soils of the rarer elements such as boron, copper, zinc, and manganese. In a number of cases these diseases have been cured by applications of compost or farm yard manure, which contain most of these rarer elements in minute, but sufficient quantities. A boron deficiency disease of oranges has recently been demonstrated on the Mazoe Citrus Estate.

It may perhaps be claimed that sufficient has been said to indicate the intricacy of the problem " How does compost work ? " It is such a vast subject that despite the tremendous amount of research which has been devoted to it in recent years it is certain that this question cannot be answered in full for many generations, if ever. Nevertheless, the farmer can remain assured that he has in compost a valuable and cheap source of fertility for his soils, which normally requires reinforcement only with comparatively small additions of phosphate to make it suitable for use for all our principal farm crops.

That some 615 of our farmers have made, during the past year nearly 150,000 cubic yards of compost is sufficient evidence that its value is being widely appreciated. And the fact that individual farmers have made such large quantities during the year as 4,320, 4,400 and 3,000 cubic yards respectively indicates that it is cheap to make, and this is supported by accurate costings which are now available.

EFFECT OF THE SOIL MULCH.*

FORMERLY it was accepted without question that the loosening of the first few inches of surface soil by means of harrows or other implements was an aid to the conservation of the moisture in the lower soil. In spite of the fact that many findings during the past twenty years cast some doubt on the validity of this theory, there are still many farmers who believe in the effectiveness of a soil mulch under dry-land-farming conditions. The reason for this belief is partly due to the fact that the movement of moisture in the soil is not always correctly understood.

REAL AND APPARENT CAPILLARY MOISTURE

Capillary moisture such as appears in the soil can be divided into two types, viz., real capillary moisture and apparent capillary moisture. *Real capillary moisture* occurs in conjunction with underground water, *i.e.*, within two or three feet above the level of underground water. In this zone the typical capillary movement of the moisture can be detected and may be compared with that of paraffin in the wick of a lamp. This upward movement can be inhibited by breaking the capillary tubes. In practice, therefore, the loss of moisture as a result of evaporation on the surface can be reduced by cultivation, *i.e.*, by establishing a mulch. It seldom occurs, however, that the natural level of underground water is only three feet below the surface of the soil.

If dry soil is irrigated and it is found after a while that the soil is moist to a depth of four feet, those four feet of surface soil are said to be saturated to their " field water capacity ". The movement of moisture to the drier sub-soil takes place very slowly, since this type of moisture, which is also known as *apparent capillary moisture*, moves mainly in the form of vapour. The same applies to the loss of moisture to surface soil already desiccated. A break-down in the capillary tubes in the soil caused, for example, by cultivation can therefore have only a slight practical effect, if any, on the conservation of moisture in the soil.

As long ago as 1914 Burr found that a soil mulch does not to any marked extent prevent the loss of soil moisture, and in 1917 Harris and Jones expressed the view that *cultivation of the soil was much more important as a means of controlling weeds than of maintaing a mulch for moisture conservation.* Little attention was given to these views, however, since the results achieved by other research workers appeared to prove the contrary ; but when Veihmeyer came to the same conclusion in 1927 his findings were accepted by experts as

* By L. L. Eksteen and Dr. M. van der Spuy, Glen College of Agriculture, in *Farming in South Africa*, February, 1941.

conclusive. During 1934-35 Esselen obtained the same results on light, sandy soil. In 1938 a similar experiment was repeated on a heavy, clayey soil at the Glen College of Agriculture since it is still believed by some that a soil mulch delays evaporation in this type of soil.

PROCEDURE OF EXPERIMENT

The treatments consisted of the cultivation of the soil to a depth of four inches and the eradication of weeds at the same time as against no cultivation and the removal of weeds by hand, care being taken to disturb the surface of the soil as little as possible.

The plots measured 20 feet by 28 feet, a strip 4 feet wide being left between them in order to obviate the possibility of moisture moving from one plot to the other. Each treatment was replicated five times in a randomized block arrangement. The method of sampling adopted was that described by Esselen in the January 1937 issue of *Farming in South Africa*.

The experiment lasted from May 12, 1938, to April 28, 1939, and in all 2,800 samples of soil were taken for moisture determinations. The variation in soil texture over the whole area covered by the experiments was exceptionally small.

Table I. reflects the mechanical composition of the soil taken from one of the plots.

TABLE I.—Mechanical Composition of the Soil.

Depth	Hyg. Moisture.	>2 mm.	2–·2 mm.	·2–·02 mm.	·02–·002mm.	<002 mm.
0–12 in.	3·15	0	2·64	52·1	10·25	33·75
12–24 in.	3·45	0	1·56	44·6	13·25	37·50
24–36 in.	3·59	0	0·75	35·8	18·50	40·00

Owing to the presence of a high percentage of fine sand, clay and silt, the soil tends to form deep fissures on drying. If the soil is somewhat dry, cultivation is exceptionally difficult, since large hard clods are formed. Irrigation water is absorbed very slowly.

The experiment was commenced on May 12, 1938, when all the plots were irrigated, 4 inches of water being applied. On May 21, the first samples were taken and on May 24, the five cultivated plots were loosened to a depth of 4 inches with a special fork. On September 29 a second irrigation of 5·7 inches and on October 4 a third of 1·6 inches, a total therefore of 7·3 inches, were given. On October 10, samples of the plots were taken and on October 11, the soil of the cultivated plots was loosened once more. The rainfall during the period covered by the experiment is given in Table II. After every appreciable fall of rain the soil mulch was restored.

TABLE II

Date.		Precipation in inches.	Date.		Precipation in inches.
1938.			1939.		
May	14	·09	Jan.	1	1·41
June	1	·03	,,	10	·06
,,	9	·02	,,	11	·30
,,	10	·01	,,	13	·06
,,	13	·06	,,	20	·09
,,	14	·24	,,	21	·41
,,	15	·09	,,	23	·15
,,	17	·06	,,	28	·14
,,	18	·13	,,	29	·12
,,	19	·07	,,	30	·70
,,	20	·06	,,	31	·15
July	6	·30	Feb.	1	·10
,,	7	·02	,,	8	·25
Aug.	2	·02	,,	11	·28
,,	27	·17	,,	13	·11
,,	28	·08	,,	14	·08
Sept.	8	·01	,,	15	·05
Oct.	2	·18	,,	17	·51
,,	3	·16	,,	21	·12
,,	4	·10	,,	22	·10
,,	10	·37	,,	23	·20
,,	21	·04	,,	28	·07
,,	24	·50	March	5	·05
,,	25	·36	,,	8	·03
,,	29	·81	,,	9	·38
,,	30	·02	,,	10	·08
Nov.	3	·36	,,	29	·08
,,	4	·26	,,	30	1·23
,,	9	·12	,,	31	·04
,,	15	·45	April	2	·57
,,	29	·42	,,	4	·20
,,	30	·76	,,	14	·20
Dec.	2	·04	,,	18	·02
,,	11	·11			
,,	18	·25			
,,	25	·44			
,,	26	·32			
,,	27	1·75			
,,	28	·05			

DISCUSSION

The results show that there is no practical difference between these two treatments. If a soil mulch is made with a view to conserving soil moisture it does not answer its purpose.

The maintenance of a soil mulch, however, offers other advantages which should not be overlooked. These advantages are the following :—

Weed Control.—There is no cheaper and quicker method of weed control than soil cultivation. If weed control is neglected crops are deprived of plant foods and moisture, with the result that production suffers. Moisture determinations made on the first foot of soil from plots in another experiment reveal that a plot overgrown by weeds contains 4·5 per cent. moisture, whereas one on which clean cultivation had been carried out, contained 7·0 per cent. moisture. The average yield of air-dried material in lb. per morgen for the two treatments in this experiment was as follows :—

Weed Infested Plots.			Clean Plots.	
Weeds.	Stalks.	Grain.	Stalks.	Grain.
lb.	lb.	lb.	lb.	lb.
8,852	3,015	160	5,777	1,718

These figures clearly prove the following :—

(1) Weeds deprive crops of moisture.

(2) The high yield of weeds must necessarily remove many nutrients from the soil. Fertilizing of the soil should be practised in conjunction with cultivation.

(3) Under conditions such as those which prevailed during the experiment, the grain yield may be increased ten-fold, provided proper cultivation is carried out.

In these circumstances, therefore, there is little danger of over-cultivation in maize lands, since the weeds grow apace during the summer months. The most effective method of control is cultivation while the weeds are still in their early stages of growth.

Reduction of Run-off.—Soil cultivation directly aids the conservation of rain water since it improves the absorption capacity of the soil, thereby greatly reducing run-off. It is during heavy downpours that the beneficial effect really becomes obvious. In another experiment carried out at Glen, it was established that the percentage of run-off was as reflected in Table III.

TABLE III.—Run-off from Uncultivated and Cultivated Soil

Precipitation	Time (in minutes)	Run-off from Uncultivated Soil per cent.	Run-off from Cultivated Soil per cent.
0·15 inch	25	8·3	—
0·21 inch	12	43·0	21·7
0·25 inch	70	9·2	—
0·32 inch	13	39·1	—
0·35 inch	34	41·3	—
0·50 inch	297	10·6	3·0
0·53 inch	65	38·0	5·3
1·29 inch	650	22·4	3·1

Prevention of Wind Erosion.—Soils containing a large percentage of fine sand and little clay tend to become wind-blown. This condition is common in many places in the Glen area, but in the western districts especially, farmers sometimes experience great difficulty with this type of soil. Drifting usually commences after the surface has been levelled by rains. Consequently, cultivation of such soils with harrows and other implements after rains with a view to restoring a broken crust in the surface soil appears to offer the only solution. In this respect the same run-off experiment at Glen yielded further interesting results. The uncultivated plot which was free from grass and other crops lost 160 lb. of soil during the period July 1, 1939, to August 31, 1940, whereas the cultivated plot which also had no vegetal cover lost only 33 lb. *i.e.*, 8 tons and 1½ ton per morgen respectively.

CONCLUSIONS

(1) From the experiments described above it cannot be deduced that a soil mulch has any noticeable effect on the evaporation of moisture from soil in which the underground water level is very deep.

(2) The crop yield can be greatly increased by controlling weeds effectively during the early stages.

(3) Cultivation of the soil reduces run-off.

(4) Soils cultivated to a rough, broken surface do not easily become wind-blown.

MEETINGS, CONFERENCES, &c.

RFPORT OF THE PROCEEDINGS OF THE SECOND MEETING OF THE CENTRAL BOARD OF AGRICULTURE HELD IN THE BOARD ROOM OF THE DEPARTMENT OF AGRICULTURE AT PERADENIYA, ON MONDAY, FEBRUARY 10, 1941, AT 11 a.m.

MR. M. CRAWFORD, Acting Director of Agriculture, presided, and the following members were present:—Sir James Obeyesekere, Sir Wilfred de Soysa, Messrs. C. Arulambalam, R. H. Bassett (Commissioner for Development of Agricultural Marketing), Dr. Reginald Child (Director, Coconut Research Scheme), Messrs. C. M. W. Davies, C. N. E. J. de Mel (Principal, School of Agriculture), R. H. de Mel, Wace de Niese, George E. de Silva, M.S.C., G. de Soyza (Registrar of Co-operative Societies), A. M. Clement Dias, T. B. Ellepola, Dr. J. C. Haigh (Botanist), Messrs. C. E. Hamilton, J. J. Heider, K. Kanakasabai, W. C. Lester-Smith, A. E. Madawala, Mudaliyar S. Muttutamby, Dr. R. V. Norris (Director, Tea Research Institute of Ceylon), Messrs. T. E. H. O'Brien (Director, Rubber Research Scheme), M. Park (Acting Deputy Director of Agriculture), Dr. S. C. Paul, Dr. W. R. C. Paul, Messrs. Wilmot A. Perera, T. B. Poholiyadde, F. A. E. Price, T. M. Saba Ratnam, Rolf Smerdon, R. H. Spencer Schrader, T. A. Strong (Conservator of Forests), S. G. Taylor (Director of Irrigation), U. B. Unamboowe, Mudaliyar H. E. S. Wickramaratne, Mudaliyar N. Wickramaratne, Messrs. A. A. Wickramasinghe, C. L. Wickremesinghe (Commissioner of Lands), Col. T. Y. Wright, and Mr. S. C. Fernando, Secretary.

The following members had expressed their inability to be present:—Messrs. H. W. Amarasuriya, M.S.C., W. H. Attfield, James P. Fernando (Chairman, Low-Country Products Association of Ceylon), Bruce S. Gibbon, R. C. Kannangara, M.S.C., T. B. Panabokke, Adigar, Marcus S. Rockwood, R. C. Scott (Chairman, Planters' Association of Ceylon), S. Sivapalan, E. R. Tambimuttu, M.S.C., and Rev. Father L. W. Wickramasinghe.

The following visitors were also present:—Dr. M. Fernando, Dr. D. E. V. Koch, Messrs. J. E. Senaratne and G. V. Wickramasekera.

CONFIRMATION OF MINUTES

The minutes of the 1st meeting were confirmed, subject to a correction from Mr. A. M. Clement Dias.

ELECTION OF EXECUTIVE COMMITTEE OF THE BOARD

The following were elected :—Sir Wilfred de Soysa, Messrs. C. M. W. Davies, Bruce Gibbon, K. Kanakasabai, Wilmot A Perera, Rolf Smerdon, Mudaliyar S. Muttutamby, and Mudaliyar H. E. S. Wickremaratne.

STATEMENT BY THE BOTANIST

The Chairman in calling upon Dr. Haigh to present his statement explained to the Board that it covered just a few of his Division's activities, and was in the form of a Progress Report since the last statement. Dr. Haigh dealt in some detail with four important crops, viz., kapok, castor, cinchona and sugar.

Kapok.—Had great possibilities in Ceylon. Ceylon kapok in England fetched sixpence a pound and was used for stuffing cushions and mattresses. Java sent a grade which fetched twopence more and was used for life-saving appliances such as life belts, life jackets, and seaplane floats. The Department found that there was no essential difference between the two grades, and their experience with a cleaning machine was happy in that it enabled them to produce a sample to be tested for the Board of Trade by the Ministry of Shipping. The samples were reported to be of the standard required for life-saving appliances, and there was a prospect of good business. If Ceylon could replace Javanese exports to Britain, Ceylon exports thereto would rise by 100 per cent. The world trade was near 30,000 tons of which Java had a virtual monopoly, but Java maintained her position owing to three factors (1) she exported a superior product (2) she guaranteed its superiority (3) she guaranteed its quality and identity. India, and even Ceylon on the other hand, appeared to send kapok adulterated with other fibres such as Bombax (S. Katuimbul), and Wara (Sinhalese) a shrub growing near the sea in the Dry Zone.

A superior product from Ceylon could tap the markets of Australia, which imported 4, 500 tons annually, the U. S. A. (15,000), New Zealand (1,200) and Singapore (1,000) tons.

Kapok was essentially a village industry. 90 per cent. of the crop in Java was grown by smallholders on their boundaries, and cleaned and exported by a central factory, and Ceylon could have a similar system. A scheme to make purchases in the villages was now with the Ministry of Agriculture, and the Department was awaiting its approval. This would be a valuable sideline in rural economy.

Castor.—Selected seed had been sent to Colombo for extraction by the British Ceylon Corporation. There were no technical difficulties. The Medical Department found it to be up to pharmaceutical standards. About two years from now the whole of the castor oil used by that Department should be from seed locally grown and oil locally manufactured.

Cinchona.—The first trial area was planted near Welimada three months ago. They were hoping to plant another area in the Wet Zone this year. If cinchona could grow in the Uva patnas there would be an enormous expansion in cultivation, as so much land was available. The experiments of the Forest Department in Welimada gave room for optimism.

Sugar.—Their first trials in the Eastern Province had been completed. They had still to learn, but it would be no idle dream to produce all the Island's requirements in due course. There were over 30 varieties to choose from without taking into account the possibilities of local breeding and improvement; they had also to determine the best seasons, agricultural practices, and above all, action in the field and reaction at the factory. Other countries had found that the best variety in the field did not necessarily give the best results in the factory.

The mention of "factory" often conjured up visions of capitalistic exploitation. But if Ceylon were to produce locally the 70,000 tons imported annually of which 92 per cent. was refined, large scale operations were inevitable. This did not however preclude the smaller grower: growing was one thing extraction another. Besides, 8 per cent. of total imports, *i.e.*, nearly 6,000 tons of crude unrefined sugar, could be supplied by village industry entirely.

Comparisons with India could be very misleading. Sugar cane had been grown there for over 2,500 years—during the whole of which the sugar industry had given the raw material for jaggery, &c. Just now the position was changing, and two years ago figures showed that India produced 4½ million tons, of which 72 per cent. was jaggery, 2 per cent. planting material, 2 per cent. factory sugar, 13 per cent. chewing and 11 per cent. local sugar refining. The bulk of the sugar in India was consumed by the peasant who wanted it, and would want it, in the form of raw sugar. In Ceylon they were starting from the beginning, and the need to be supplied was overwhelmingly of sugar in the refined form.

Mudaliyar N. Wickramaratne said he was interested chiefly in sugar as a village industry and referred to a memorandum he had sent up earlier. He had also in 1937 suggested sugar as a village industry for the consideration of the Board. Growers in Galle District seemed to need advice and help. The Department had promised to do so after experimentation. They were still experimenting.

He said there were opportunities already for crude sugar as there were over 1,000 acres of cane in Galle District. Food crops could be interplanted too.

Mudaliyar Wickramaratne referring to his visits to Coimbatore and Mysore in 1939 and 1940 drew comparisons with methods. Why not import a successful Coimbatore variety? he asked. He had heard that one such had ousted all the experimental products in Bihar, Central Provinces and the United Provinces. One variety should do for the Dry Zone and another for the Wet. The Mahavamsa was authority to show that we grew sugar cane 2,000 years ago. In early British times the Elphinstones and Winters had produced sugar cane and his own grand uncle had a steampower plant for making sugar. They were all varieties from Mauritius. When he (the speaker) visited Kiliveddi lately he was disappointed with the whole experiment and worst of all a rubber roller was used for extracting juice. He added that he thought this work was one for an agricultural chemist rather than a Botanist.

There was tremendous overproduction in India, but an International agreement had banned exports. A barter arrangement of Ceylon coconuts for Indian sugar might however be considered.

Answering Mudaliyar Wickramaratne, *Dr. Haigh* said that 11 varieties from Coimbatore were planted. India had experimented for thirty years, not thirteen. Ten years ago less than 25 per cent. of Indian grown sugar was of improved varieties, but the figure is increasing year by year. This Department's experiments had lasted only sixteen months. Indian research had established that sampling of the kind done in Ceylon was quite reliable and that large scale extraction-trial, at least at the preliminary stages, was not necessary. Dr. Joachim, the Chemist, was now looking out for small-scale machinery in India.

Mr. George E. de Silva inquired what was the best elevation for cinchona and where seeds were available. He had found it difficult to obtain seeds from the Department, although at one time it was an industry like tea or rubber. About sugar cane experiments he thought there should be a more practical approach.

Col. Wright said he once obtained seed from an Up-country estate, but most of it was destroyed by insects. Many years ago he had an estate on which there were thousands of trees, but cinchona went down to a penny a pound and all the trees were cut out.

Mr. Rolf Smerdon asked where he could see a kapok cleaning machine and what was its approximate cost.

Mr. R. H. Spencer Schrader asked whether kapok was used as an insulating material for refrigerators.

Sir James Obeyesekere inquired whether the Department could not obtain supplies of cinchona seed from Java and Sumatra.

Dr. Haigh replying *seriatim*, said : *Cinchona.*—They were trying *ledgeriana*, the best of all varieties with the highest quinine content, and *succirubra*, which though more vigorous in growth contained less quinine. A hybrid was also being tried to preserve the virtues of both with more quinine content than *succirubra*. *Robusta* a fairly stable hybrid and *officinalis* were also being tried. *Ledgeriana* was the one really wanted and most grown. The elevation for cinchona was anything over 3,000 ft. There was plenty of *succirubra* seed available in Ceylon. Dalhousie Estate in Maskeliya produced *succirubra* and supplied seeds. Other varieties were all imported for trials and the plants were still too small to supply seeds. The quinine content of *succirubra* was about 1 per cent. Java had an average quinine content of 10 per cent., Bengal 6 per cent., and Madras between 4 to 4½ per cent. Java had strictly prohibited the export of seeds, and in 1938 he was told at a demonstration that all the seed used had been poisoned.

Kapok.—The cleaning machine could be seen at the Experiment Station. Kapok was very largely used for insulation, particularly of refrigerators. He thought all American refrigerators used kapok.

Mr. C. Arulambalam mentioned that the All-India Village Industries Association had popularized a machine costing Rs. 50 which could manufacture sugar not only from the sugar cane, but also from the juice of palm trees. They were trying to have 2 or 3 of these machines in Jaffna, to experiment on palm juice.

The Chairman summing up the economic aspect of sugar said that as 92 per cent. of Ceylon's needs were supplied by refined sugar, manufacture had to be by factory methods, whilst village industry could supply the 8 per cent. unrefined. Dr. Haigh's experiments had gone far to indicate the types that grow well in Ceylon and they were all grateful to him for his paper.

RESOLUTIONS

Co-operative Colonization

Mr. C. Arulambalam moved the following resolution :—

> " The Central Board of Agriculture is of opinion that, in connexion with the development of Colonization Schemes in Ceylon encouragement should be given to the establishment under such Schemes of Agricultural Settlements on a co-operative group basis ",

explaining that Agricultural Settlements on a group basis had been successful in Malaya, where 59 settlers had taken up 243 acres for development on a co-operative basis first, before parcelling out to the individual members. Thereby development became more thorough and also less expensive. He understood the Registrar of Co-operative Societies had a similar scheme in view based on a Burma model—the Sittang colonies.

Mr. G. de Soyza (Registrar of Co-operative Societies) supported the proposal and added that such schemes had been worked with success in the East. In Palestine all Jewish emigrants had been settled on the land co-operatively, but co-operative colonization presupposed a high degree of co-operative quality and the Jews were co-operators by nature. Success depended largely on the co-operative quality of the individual colonists. He had advocated the Burma model for Ceylon, and between the Land Commissioner and himself a scheme should in due course be ready for submission to the Minister.

Mr. Kanakasabai thought the new Land Ordinance precluded co-operative development.

Mr. C. L. Wickremesinghe (Land Commissioner) said he was very glad that colonization was creating such public interest. The co-operative principle had not been thought of at the start, but it was hoped to introduce it soon in the light of Indian and Burman experience. Even now a mere theoretical study of their reports gave no inkling of the enormous practical difficulties the settlers must have had to face, but Mr. de Soyza hoped to get more information.

This principle had been introduced into the Scheme for schools, accounts of which had appeared lately in the press.

There was no legal difficulty as feared by some members. When land is alienated under the Ordinance there were certain restrictions on individuals ; but land could be alienated outside the Ordinance, and then Co-operative Societies can have it in perpetuity, giving individual title if necessary.

Mr. Wilmot A. Perera inquired whether the State Farm Scheme was connected with this.

Mr. C. L. Wickremesinghe said it was on somewhat different lines. The State Council would be taking it up soon.

The Chairman remarked that all seemed to favour the motion, and he would commend to the Board a small colony at Kurundankulam near Anuradhapura, now four years old, which was based on co-operative principles. In a week there was to be a field day, and members of the Board would be welcome to see the success attained so far in a novel method of development.

Mr. Rolf Smerdon suggested a slight amendment to the motion, and the mover accepting, the following was put to the Board and adopted unanimously—

" that the Central Board of Agriculture recommends that, in connexion with the development of Colonization Schemes in Ceylon, encouragement should be given to the establishment under such schemes of agricultural settlements on a co-operative group basis ".

Taxation of Village Cattle

Mr. Wilmot A. Perera in moving the following resolution :—

" That the taxation of cattle and buffaloes for revenue purposes by Village Committees is not conducive to the improvement of Peasant Farming, and this Board desires that the Ministries of Agriculture and Local Administration should direct Village Committees to explore all other avenues of taxation prior to the imposition of a tax on animals used for Agricultural Purposes " :

said that, in the Kalutara District, Village Committees had already started taxing dogs, donkeys, elephants, &c. He was concerned mainly with animals used for agricultural purposes. Perhaps on the taxation of cattle there were two schools of thought. There would soon be a land tax, and one never knew to what lengths Village Committees might go to add to their coffers. He intended his motion as a sort of *caveat* against taxation highly detrimental to agricultural development.

Mr. Wace de Niese seconding, thought it would be better if the Minister for Local Administration could be asked to restrain these Committees.

Mr. George de Silva pointed out that these being self-governing institutions could not be dictated to. Instead, public opinion should be roused to restrain members in such matters.

Mr. K. Kanakasabai remarked that without good pasture grounds livestock were more a burden than a relief to the cultivator. He said " cultivator " deliberately because the owner allowed his cattle to stray and forage over other people's properties. He thought a tax would weed out the unfit and encourage better breeds.

Mr. Rolf Smerdon said if an animal was worth owning it was worth paying a small tax for. The villager should be able to pay 25 cents on worthwhile cattle. He was opposed to the resolution.

Mr. A. M. Clement Dias said that Village Committees did not mirror public opinion accurately, and even the State Council did not. Village Committee members were influential people who cared little about the poor owners of cattle. Many estates, spurred by the Cattle Breeders' Association, kept cattle for breeding purposes, and a tax was sure to discourage estate owners

and thereby nullify its object if it was to promote a better breed by weeding. Estate labourers had no vote and owners would therefore have no voice on the Committees.

Mudaliyar S. Muttutamby said that useless cattle were a real problem in the Dry Zone. The good bulls in the third or fourth year were castrated for cart work, and the useless ones were allowed to roam and breed. He thought a tax was essential to reduce numbers.

Mudaliyar H. E. S. Wickramaratne suggested that cattle used for agricultural purposes should not be taxed till Village Committees were able to provide pasture.

Mr. R. H. Spencer Schrader said if an animal was worth breeding it was worth a tax of 25 cents a year.

The Chairman then intervening said the first part of the motion appeared to contradict the second. He thought what Mr. Perera had in mind was that animals used for agriculture might not be taxed. Replying to Mr. Smerdon he added, the animal that is trained is used and the untrained is not used. Animals were used for manure, cultivation and breeding. He suggested adding after the words " for revenue purposes by Village Committees " the words " which are used for purposes of agriculture ".

Mr. C. L. Wickremesinghe said that according to Mr. George E. de Silva neither Minister could give direction to a Village Committee.

Dr. R. V. Norris (Director, Tea Research Institute) suggested substituting after the word 'desires' " that the attention of Village Committees should be called to the desirability of exploring other avenues of taxation ".

Mr. Wilmot A. Perera said all he wanted was to bring these views to their notice.

Mr. C. L. Wickremesinghe suggested forwarding this information to the District Agricultural Committees. After some discussion the Chairman read the text of the following amended resolution which was accepted by the Board, with Mr. Rolf Smerdon dissenting :—

" That the Central Board of Agriculture is of the opinion that taxation of cattle and buffaloes which are used for agricultural purposes by Village Committees is not conducive to the improvement of peasant farming, and desires that the attention of Village Committees should be called to the desirability of exploring other avenues of taxation ".

Organization of Cattle Breeders' Associations

Mudaliyar N. Wickramaratne moved the following resolution :—

" That it is the earnest desire of those who are interested in the rearing of local cattle that the Director of Agriculture should organize an association or associations on the lines of the Cattle Breeders' Association of Ceylon for the improvement of the indigenous cattle ".

He referred to the formation of the Cattle Breeders' Association 3 years ago following a memorandum by a sub-committee appointed by the Board. He was sorry to see nothing done to improve the breed of indigenous cattle. At the

present pace no appreciable results were likely for another 50 years. The subscription for membership was Rs. 10 a year, which kept out the poor folk. Everybody knew the value of implemental cultivation, and for this cattle were required. If the estimate of paddy acreage at 800,000 acres was correct, then allowing a pair for 2 acres, over 400,000 pairs would be needed, and to get this number the total cattle population will have to be over 1,200,000. So we cannot have too many cattle for a long time.

He repeated that the Cattle Breeders' Association assisted only the well-to-do as it had only the outlook of the well-to-do 150 members paying Rs. 10 per head. He wished to see local associations spring up in the villages to improve village agricultural cattle and take measures to provide adequate pasture. He had read in the press that Agricultural Instructors and others down South had already formed such an association in the Southern Province.

Mr. K. Kanakasabai seconded.

Col. Wright inquired whether small Cattle Shows had not been organized by the Board.

Mudaliyar H. E. S. Wickramaratne remarked that his District Agricultural Committee in Matara had already taken steps to organize district shows.

Mr. A. M. Clement Dias said that as a member of the Cattle Breeders' Association he could say they had done a good deal. During the Colombo show last year they had granted Rs. 200 to enable villagers to bring their cattle. With more funds they could undertake to do more for villagers.

The Chairman, speaking as a member of the Association, said the mover's criticisms were not justified. It was incorrect to say the Cattle Breeders' Association were not interested in village cattle, nor was it solely interested in dairy and milk production. There had been a spate of cattle shows lately, *viz.*, at Kurunegala, Wagolla, Marawila and Mirigama, &c. The Association was very keen to get at the villager. Members were keen on organizing shows in the villages, and a clause in the Show Regulations enabled fees to be waived from village cattle. Personally he preferred to see the Association deofficialized, but if so far the important office-bearers happened to be high officials it was not because the Department was anxious to dominate.

Mr. R. H. Spencer Schrader said that the Mudaliyar appeared to expect quick results. With village breeds results were slow as they matured slowly. It required five years to raise a generation. In the first generation improvement was very slow. Noticeable improvement came only with the second, and it was really true that nothing much could be done under 50 years. We were dealing with not machines but livestock.

Sir Wilfred de Soysa recalled the remarks of His Excellency the Governor when opening the Show in 1939 recommending that the Association should take the initiative in forming associations all over the country. As a member he could say that everything would be done whenever opportunity arose.

Mr. C. Arulambalam suggested the District Agricultural Committees as suitable media for the popularization of the proposed activities.

Mr. C. L. Wickremesinghe said he would like to move the following amendment :—

" That it is the earnest desire of those who are interested in the rearing of local cattle that the Director of Agriculture should consider the possibility of forming suitable organizations for the improvement of indigenous cattle. "

Mr. H. E. S. Wickramaratne seconded.

The mover agreeing, the motion in this amended form was put to the Board and carried unanimously.

It being 1 o'clock the Board adjourned to lunch.

Planting of Palmyrah on Waste land

Resuming at 2.30 P.M. the Board proceeded to consider the following resolution by *Mr. C. Arulambalam* :—

" That with a view to improve the conditions in the dry zone of the Island particularly in the spheres of economic benefit and nutrition this Board recommends, for the favourable consideration of Government, the planting up with the palmyrah palm of the waste land in the dry zone suitable for the growth of that palm, the planting to be done systematically and spread over a number of years with the view to minimize as far as possible the cost and labour involved. "

The mover referred to the memorandum he had circulated and dwelt in some detail on the merits of the palm as a food and a provider. He was glad the Department had made many investigations on the various products, and the Chemist had confirmed the value of its leaf as suitable feeding stuff for cattle, which was a welcome solution to the pasture problem in times of drought.

He then read a passage from Professor T. M. Carver, Professor of Rural Economy at Harvard University, in support of his argument that it was the duty of the State to plant up waste land with whatever was suitable.

Mudaliyar S. Muttutamby seconding the motion said he was concerned particularly with Mannar District. Planting of palmyrah caused very little trouble.

Mr. K. Kanakasabai thought a good deal of co-operation was necessary between the Forest and Agricultural Departments in this matter. He had seen for himself the many failures of the Forest Department in reafforestation owing to the ravages of wild animals and adverse climate ; the palmyrah would present fewer difficulties as it grew on any soil and was immune from depredation after the third year. A newer impetus would also be given to the toddy industry.

Dr. S. C. Paul recalled an expression of opinion by him to the press some years ago that for Colonization to be successful in the North-Central Province the palmyrah should find a prominent place in cultivation. It gave the settler his food, building materials and manure ; its toddy was a good preventative, if not too fermented, as it contained vitamin B complex in the highest form of concentration. It was also a wonderful prophylactic against malaria, and he had come to this conclusion after careful comparison of conditions between

South India and Ceylon. Under exactly similar conditions the former seemed to be immune from malaria, and his explanation was the extensive plantations of palmyrah there. He heartily supported the motion.

The resolution was carried unanimously.

Chemical research on paddy soils

Mr. K. Kanakasabai moved the following resolution :—

> " That this Board recommends that the Agricultural Department should undertake as early as possible chemical research on paddy soils of the important tracts with a view to ascertain to what extent the loss of plant food has proceeded and what manures are necessary for replenishing the supply and whether the soil is capable of producing the maximum crop under proper management. "

The Chairman explained that Dr. Joachim, who had prepared a short note, was away in India, but his assistant Dr. Koch was present to read it.

Mr. Kanakasabai emphasized that it was a vital problem as more than one factor was really involved. First, there was no perennial source of water for irrigation ; second, there was considerable soil denudation ; third, wastage of water was inevitable in diverting supply ; fourth, paddy land remained always paddy land in Ceylon, without rotation.

The soil contained the various chemical elements necessary for plant growth, and the problem of agriculture was always to restore to the soil what was removed in cultivation. But water was necessary for the absorption of food by a plant. This was one reason why some paddy growers generally plough with the sowing of paddy. Others thought it disadvantageous to sow paddy in sodden land. In certain tracts ploughing in dry weather and sowing in pulverized soil gives the best results, so that the system adopted in one locality would not do always for another.

Therefore a thorough chemical analysis of the soil was necessary. Many believed that green manure was superior to artificials in paddy cultivation but green manure did not suit every soil, because if the trenching of green material was deficient, a toxin arose to affect the growth of the plant. Only a soil survey could reveal the ideal manure. If such data were available when the Minneriya Scheme was launched much money could have been saved. A good scheme would be to classify all the tracts and call for chemical research. Madras Presidency had made great strides after such surveys. He hoped Mr. Rodrigo would return from India full of such information.

Mudaliyar N. Wickramaratne seconding said the information when available should be disseminated.

Dr. Koch first read Dr. Joachim's statement which was a *resumé* of the work already done by the Department, and proposed to be done. It emphasized that the extent of the losses of plant food depended largely on the original composition of the soil. Old paddy tracts could not yield this information. Tracts newly opened were better for the test, but even if the information were

available it would be of little practical value. What was much more important was the knowledge of the present nutrient status of these soils. On this he drew reference to :

Departmental Bulletin No. 57 by A. Bruce on "paddy soils of Ceylon" and paper XI. of the Series on "Ceylon Soils", by Joachim and Kandiah, published in *The Tropical Agriculturist*, April, 1938.

But soil analysis always had its limitations. It alone could not assess correctly the crop-yielding capacity or the available plant food. Many other factors mattered *e.g.* (1) variety of crop (2) climate (3) system and degree of cultivation (4) water supply.

Under "Climatic conditions" the question of sunshine was of great importance. Data available during five years showed that, provided irrigation water was supplied in adequate quantity, yields of paddy were governed by the amount and intensity of sunshine during the growing season. In the Dry Zone, for instance, the shorter *yala* season gave higher yields. Manuring appeared to be of limited value in a season of poor sunshine.

In cultivation and crop yields, experiments had shown that the use of a Ceres or improved iron plough increased yields by 25 to 30 per cent.

Manurial trials had also been extensively carried out with both artificial and organic manures. It was after a trial that the use of green manure had been made a condition for the free issue of bonemeal under the Food Drive.

Dr. Koch speaking on his own said that the "soil profile" had become a subject of intensive study lately and he was now checking up to ascertain why certain fields in Nawalapitiya and Kurunegala districts gave higher yields. To recommend a suitable fertilizer it was essential that there should first be a profile representative of an area and a volume of the soil up to a depth of two feet.

Dr. R. V. Norris said he had much to do with experiments in Madras as he was Agricultural Chemist at the time. Results would have been quicker and more effective with field trials than with purely analytical work. To determine certain features such as salinity and alkalinity chemical analysis was necessary, but as a general guide far more information could be got from actual field trials.

Mr. S. G. Taylor, Director of Irrigation, said the Ministry had laid down a standing order that soil surveys should be carried out before a scheme was passed to the Irrigation Department.

Mr. K. Kanakasabai, replying, said that sometimes the question to be decided was whether cultivators should cultivate in *yala* or *maha*. The Unichchai scheme, for instance, was designed entirely for *munmari* as there was no water. Field officers should where possible benefit from the experience already gained by cultivators and complete trials on such matters as saving the water supply, in order to expand the area under paddy. In the report for 1939 the Director of Irrigation had observed that such schemes were designed for *munmari*, (*maha*), making a *yala* crop thereby unnecessary.

The Chairman said he welcomed the resolution as the chemical division had been strengthened with the appointment of Dr. Koch, and another officer was returning soon after his training. A big problem was provided by Major Irrigation Schemes which had been designed and costs estimated on the basis

that they would irrigate a *maha* crop but which in practice had been used more as *yala* schemes. As a result the area of land which could be irrigated was much less than was contemplated when the schemes were designed. Chemical investigations would never convince the cultivators under such schemes that they could and should grow a long-aged paddy instead of their present short-aged ones. That could only be done by convincing demonstration on the land under the irrigation schemes in question. The organization of such demonstrations was under consideration at the moment.

The resolution was carried unanimously.

Marketing and Irrigation

Two resolutions originally standing in the name of Madukande Dissawe, late member, were then sponsored by Mr. T. M. Saba Ratnam, but before he had proceeded far he requested permission to withdraw both and re-introduce them in an amended form as he was not wholly in sympathy with either.

As the Board assented, Mr. Wilmot A. Perera raised a few questions on

Priority Lists

He wished to know why schemes which had been on the list over 3 years ago were being re-introduced. It was perhaps due to the change of District Irrigation Engineers. There seemed to be some confusion in these matters.

Mr. S. G. Taylor, Director of Irrigation, replied that they had several large schemes in areas in which Mr. Wilmot Perera was interested, mostly of the salt water exclusion variety which were very difficult, and required extensive investigation and could not in consequence be finished in one year. The general practice with regard to items on the priority lists was to investigate an item one year and construct it the next. This had been followed all over the Island and had proved very satisfactory, but in the Southern Province and also in Kalutara District where they had several of these exclusion schemes, such simple procedure was not always possible.

Replying to further interpellation Mr. Taylor said that some Divisional Irrigation Engineers were too optimistic as to what could be done in one year. In other cases District Agricultural Committees disregarded the advice given to them by the Divisional Irrigation Engineer and pressed him to take more items on the lists. Practice showed that their optimism was not justified and as a result the same scheme appeared in subsequent lists.

Training Classes for Sinhalese and Tamil speaking students

Mudaliyar N. Wickramaratne next moved the following resolution :—

> "That this Board is of opinion that training classes for the training of Sinhalese and Tamil speaking students who have passed Junior and Senior School Leaving Certificate Examination in the Vernacular should be started at the School of Agriculture, Peradeniya, from the year 1941."

The trend of educational policy now, he began, was to use the mother tongue as the medium. Government was making a knowledge of the local languages compulsory for Government servants, and the Courts were likely to conduct proceedings before long in Sinhalese and Tamil. Besides, English education

was becoming very expensive in Ceylon. Therefore it was reasonable that agricultural training should be in the vernaculars. Even the English-educated would often have to work in the villages with those ignorant of English. At present vernacular training was given to a few teachers, but the process of educating the massess in this way would be very slow. Even the classes for headmen had been discontinued.

Mr. K. Kanakasabai seconded as he though it a very desirable scheme.

Mr. A. M. Clement Dias inquired whether a practical training was not given at Labuduwa and Wagolla.

Mr. Rolf Smerdon inquired what efforts the Department made to secure employment for students who completed their training.

The Chairman explained there were two types of training at the Agricultural School, Peradeniya, and the Principal would be glad to give details.

Mr. C. N. E. J. de Mel (Principal, School of Agriculture) wished to know first from the mover what particular type of training he had in view and what purpose he had in mind, and it was explained that the object was to give education to those who knew no English.

Continuing, Mr. de Mel said he believed the Mudaliyar's idea was not to make Sinhalese and Tamil the sole media of instruction. When the Farm School at Peradeniya was established in 1916 there were classes in Sinhalese and Tamil also. Some minor headmen were admitted to these. The Tamil classes were subsequently transferred to the Tinnevelly Farm School at Jaffna, but the Sinhalese classes were continued, with no headmen but Sinhalese teachers selected by the Director of Education. 12 such men were trained every year and last year they had 15. There had been many inquiries from those who were not teachers, but every prospective student also wanted to be informed of the prospects of employment after training.

The training of the type the Mudaliyar desired was already available throughout the Island at the various practical farm schools. But in the speaker's view, the sort of men the Mudaliyar had in mind would prove much less successful than the less educated men who came there with the object of returning to the land and developing their own agricultural resources : the former, he feared, aimed primarily at employment on other people's lands, or betterment of prospects in teaching, or other careers.

In 1936 Peradeniya had only 24 men in the English classes. There are now 80. There were, as already mentioned, 15 in the Sinhalese classes, and in addition apprentices and casual students were also trained, bringing the grand total to about 90 a year. He would say, therefore, subject to decisions on policy by the Honourable the Minister, that there was little scope for multiplication of courses with present staff and accommodation.

The distribution of the various practical farm schools throughout the Island was as follows, all the men being in residence :—Tinnevelly with 23 men, Labuduwa 16, Mapalana 12, Wariyapola 20, Karadian Aru 27, Wagolla 24—a total of 122. There would soon be four more, Horana with accommodation for 24, Nalanda 20, Walpita 20 and a school in Animal Husbandry at Ambepussa Farm for 24 men. The total will then be 210. No doubt the number of these schools will progressively increase.

Selection for admission to these was made very carefully by Revenue Officers, and deserving men could apply. Personally as Principal he thought it unwise to add to the strain on the Peradeniya School as staffed and equipped at present. To the criticism that the practical farm schools gave only 1 year's training he would reply that it was just what was wanted by practical-minded men who wished to return to their land for cultivation of paddy and annual crops. Actually the type of training given in Peradeniya was unsuited to this class of men. The curriculum at Peradeniya was admirably suited to those who by their knowledge of English were able to found on a sound scientific basis a useful training in practical agriculture. He submitted the same did not apply to students whose educational record did not rise above the standard maintained in village schools. They benefited far more by a strictly practical bias which the existing Farm Schools provided at present.

Mr. Rolf Smerdon inquired the cost per student per year at Peradeniya and elsewhere.

Mr. de Mel said the Peradeniya School charged fees only from those in the English educated classes. The Sinhalese teachers there paid no fees : they drew their salaries from Government while under training. Students at the practical schools were given free accommodation and a mess allowance of 50 cents a day.

Mr. Rolf Smerdon : that is about Rs. 180 a year.

Mudaliyar H. E. S. Wickramaratne remarked that the mover's object could be attained by increasing admissions to the farm schools, but Mr. de Mel pointed out that each had now reached the limit of its capacity.

The Chairman said the remedy was of course in adding to the number of practical farm schools, as they were steadily doing. He was still not quite sure, however, exactly what type of training the mover had in mind.

Mudaliyar N. Wickramaratne replied that he envisaged the same education in agriculture as was imparted in Peradeniya, for those who were educated in Sinhalese and Tamil up to a certain standard. The present farm school courses really catered for sons of farmers ; he wished to bring in those others who could never hope to acquire an adequate knowledge of English and thereby educate themselves by reading scientific books. The period of training should also be 2 years instead of 1.

The Chairman.—The two years' course at Peradeniya is mainly to train men for employment in the Department of Agriculture as instructors ; more than half of the students taking the 2 years' course are intended to become instructors. Unless English is used as the medium of instruction these students will be cut off from use of scientific text books necessary for their education as we have not yet got scientific text books in Sinhalese and Tamil. In the practical farm schools the training is largely practical. The object is not to turn out Instructors but to turn out practical agriculturists. There would be little point in making the practical farm schools replicas of the Peradeniya School of Agriculture. The object the Mudaliyar had in view would best be met by increasing the number of practical Farm Schools.

Mr. de Mel thought that as long as we had English education in this country it was not feasible to teach students from secondary schools their agriculture in Sinhalese or Tamil. For them even a two-year training was inadequate to ground them thoroughly both in annual crops and in plantation crops like tea, rubber and coconuts. The men contemplated by the mover were not seriously interested in plantation crops. By using English as the medium the school at Peradeniya was able to offer the fullest benefit from a study of scientific subjects like Chemistry and Botany. Just as the present curriculum was designed to benefit a particular type who could benefit by their knowledge of English, in his opinion a definite reorientation was necessary before they could hope to meet the needs of the type of student the mover had in view.

Mudaliyar N. Wickramaratne said he still thought that this type should not be shut out.

The Chairman winding up the discussion said the matter had now been thoroughly ventilated and it was clear that to double the length of the present vernacular courses in the farm schools it would be necessary to halve the number of students. Training for vernacular speaking students was directly available at the Practical Farm Schools. The type of training given on the 2 years' course at Peradeniya made it necessary to use English. From what had been said he thought that the Board would endorse that what the motion contemplated was already being done, but the Department could not promise any large institution at Peradeniya for the vernacular classes.

This was assented to.

OTHER BUSINESS

Under any other business the Chairman inquired about the time for the next meeting. The additional morning session this time had helped them to clear the agenda and he wondered whether they should not revert to the single afternoon session. Of course if the agenda was particularly heavy the Chairman could in his discretion arrange to start in the forenoon.

Various members then suggested ways and means of expediting business, such as a time limit for speeches, the exclusion of history, particularly ancient history, from discussions, and also the safe burial of subjects which had appeared and been adequately discussed in *The Tropical Agriculturist*.

The Chairman commenting on the last suggestion pointed out that everybody did not read *The Tropical Agriculturist* and, even though the subject might not be new, discussion was a good opportunity for reviewing one's knowledge and letting people know about new developments.

What really mattered, he thought, was an effort by the Chairman to prune the agenda hereafter by being stricter over resolutions which served little purpose, and by members to expedite business by confining themselves to matters on which they possessed special knowledge and refraining from repetition.

The meeting terminated at 4.20 P.M.

S. C. FERNANDO,
Secretary, Central Board of Agriculture.

Peradeniya, March 10, 1941.

ANIMAL DISEASE RETURN FOR THE MONTH ENDED MARCH 31, 1941

Province, &c.	Disease	No. of Cases up to date since Jan. 1, 1941	Fresh Cases	Deaths	Recoveries	Balance ill	No. shot
Western	Foot-and-mouth disease	..	..	..	..	..	..
	Rabies	8	4	4	..	..	4
	Piroplasmosis	1	..	..	1	..	..
Colombo Municipality	Rabies	12	1	12	..	..	..
	Hæmorrhagic Septicæmia	1	1	..	1	..	..
Cattle Quarantine Station	Anthrax	6	2	6	..	..	..
Central	Foot-and-mouth disease	2	2	..	..	2	..
	Rabies	28	4	6	..	..	22
	Bovine Tuberculosis	6	..	..	..	..	6
Southern	Foot-and-mouth disease	43	..	2	41	..	..
	Rabies	5	3	..	..	..	5
Northern	Foot-and-mouth disease	178	130	..	168	10	..
Eastern	Foot-and-mouth disease	23	.	3	20	..	..
	Rabies	4	1	..	..	..	4
North-Western	Anthrax	18	..	18	..	..	..
	Rabies	3	1	..	..	..	3
	Contagious Mange	8	..	1	7	..	..
North-Central	Hæmorrhagic Septicæmia	43	13	43	..	..	..
Sabaragamuwa	Rabies	2	1	2	..	..	..
	Piroplasmosis	3	2	..	3	..	.

Department of Agriculture,
Peradeniya, May 1, 1941.

M. CRAWFORD,
Deputy Director (Animal Husbandry)
and Government Veterinary Surgeon.

METEOROLOGICAL REPORT, MARCH, 1941

STATION	TEMPERATURE				HUMIDITY		Amount of Cloud	RAINFALL		
	Mean Maximum	Difference from Average	Mean Minimum	Difference from Average	Day	Night (from Minimum)		Amount	No. of Rainy Days	Difference from Average
	°	°	°	°	%	%		Ins.		Ins.
Agalawatta ..	90·8	+0·9	72·6	+0·3	74	98	4·0	5·61	12	—
Anuradhapura ..	92·4	+1·5	72·7	+1·2	59	93	3·6	3·09	6	— 0·55
Badulla ..	83·6	+1·4	64·2	—0·1	64	91	4·2	4·72	10	— 0·85
Batticaloa ..	86·6	+1·2	75·5	+0·5	72	91	4·3	0·75	7	— 2·60
Colombo ..	89·5	+1·8	74·3	+0·3	65	90	5·3	0·77	6	— 4·10
Diyatalawa ..	78·8	+1·7	58·2	+0·2	60	85	5·2	6·28	14	+ 1·33
Galle ..	86·8	+0·5	75·7	+0·6	74	88	4·0	3·34	6	— 2·87
Hakgala ..	75·6	+2·6	50·8	—0·8	64	93	5·1	5·58	9	— 1·12
Hambantota ..	87·5	+0·7	74·4	+0·3	72	90	5·2	5·01	5	+ 1·18
Jaffna ..	90·2	+1·8	76·7	+0·9	67	84	4·0	0·35	2	— 1·48
Kandy ..	90·8	+2·7	68·3	—0·3	62	90	4·8	4·17	10	— 1·66
Kurunegala ..	94·4	+1·9	72·4	+0·5	58	93	4·2	2·53	6	— 3·45
Lunuwila ..	91·6	+2·0	74·4	+1·2	67	93	4·4	1·02	4	—
Mannar ..	89·7	0	75·6	+0·4	66	86	3·9	0·02	1	— 1·70
Nuwara Eliya ..	72·7	+1·9	44·7	—1·5	60	93	6·5	4·77	8	+ 0·45
Puttalam ..	91·6	+2·0	73·7	+1·0	67	90	3·7	1·08	2	— 2·25
Ratnapura ..	92·5	+0·5	73·9	+1·4	67	90	6·0	7·79	20	— 3·16
Talawakele ..	79·5	+2·0	54·8	—0·4	54	78	5·0	5·62	11	—
Trincomalee ..	86·5	+1·2	76·9	+0·5	70	86	4·0	1·05	4	— 1·31

The greater part of the Island received less than its due share of rainfall during March, but deficits were, on the whole, not particularly large except in the west. In parts of the hill-country, but more especially in the southern and south-eastern midlands, an excess rainfall was recorded.

The only excess of over 10 inches was 14·85 inches at Keenagahaella. Other large excesses included 7·52 inches at Buttala, 7·41 inches at Panilkanda, 7·40 inches at Mahawalatenna, 7·23 inches at Holmwood, and 7·13 inches at Anningkanda.

The largest deficits were 8·72 inches at Halwatura, 8·05 inches at Keragala and 7·99 inches at Sirikandura.

Rainfall totals of over 20 inches were recorded at Keenagaha-ella 26·42 inches, Panilkanda 20·67 inches and Anningkanda 20·11 inches. Over a score of recording stations, the majority of them in the North, received no rain at all during the month.

Only 5 daily falls of over 5 inches were reported, the largest being 6·35 inches at Walton on the 12th.

The first half of the month was more or less dry, and nearly the whole of the rain fell during the latter half of the month as a result of local afternoon and evening thunderstorm activity, which were fairly well in evidence. A weak northerly pressure gradient prevailed.

Temperatures were again above average. The highest shade temperature recorded was 97·7° at Puttalam on the 14th, while the lowest temperature was 35·1° at Nuwara Eliya on the same date. Humidity was below average, and cloud amounts generally about normal. Surface winds were above normal strength, direction being variable.

A fall of hail was reported from Labookelle estate (Ramboda) on the afternoon of the 25th.

D. T. E. DASSANAYAKE,
Superintendent, Observatory.

Departmental Egg Laying Competition.

An egg laying competition has been started since January 1, 1941, among the farms in the Department where poultry is kept. Eighteen stations have entred for the competition. The duration of the competition will be from January 1 to December 31, 1941.

The Farm School Dairy, Peradeniya, has taken the lead as indicated in the total number of eggs laid by the competing hens in the month of January, 1941.

The following are the particulars of competing hens at these stations :—

	Name of Station.	Hen's No.	Total Eggs laid from January 1 to 31, 1941.
1.	Farm School Dairy, Peradeniya ..	77 ..	24
		86 ..	31
		91 ..	28
		92 ..	27
		93 ..	27
		94 ..	26
2.	Central Agricultural Station, Labuduwa ..	228 ..	27
		263 ..	26
		257 ..	21
		256 ..	21
		213 ..	21
		233 ..	26
3.	Experiment Station, Anuradhapura ..	44 ..	27
		46 ..	18
		49 ..	18
		61 ..	18
		67 ..	21
		54 ..	25
4.	Government Farm, Ambepussa ..	20 ..	17
		23	19
		25 ..	19
		26 ..	22
		27 ..	20
		28 ..	25
5.	Animal Breeding Centre, Murunkan ..	94 ..	17
		177 ..	18
		146 ..	15
		180 ..	24
		112 ..	24
		134 ..	23
6.	Government Farm, Polonnaruwa ..	255 ..	22
		283 ..	21
		264 ..	18
		261 ..	20
		280 ..	19
		257 ..	19
7.	Farm School, Labuduwa	207 ..	18
		203 ..	17
		210 ..	20
		229 ..	20
		249 ..	26
		269 ..	15
8.	Mapalana Farm School	255 ..	23
		280 ..	26
		205 ..	18
		208 ..	26
		238 ..	22
		78 ..	—
9.	Batugedera Demonstration Centre, Ratnapura ..	C 7 ..	22
		C12 ..	9
		821 ..	28
		889 ..	23
		919 ..	20
		959 ..	11
10.	Central Agricultural Station, Horana ..	110 ..	20
		112 ..	18
		121 ..	23
		124 ..	13
		129 ..	14
		132 ..	24

	Name of Station.	Hen's No.	Total Eggs laid from January 1 to 31, 1941.
11.	Animal Breeding Centre, Veyangoda ..	97 ..	12
		115 ..	14
		141 ..	18
		150 ..	17
		151 ..	19
		152 ..	16
12.	Poultry Farm, Tabbowa	97 ..	21
		117 ..	7
		54 ..	16
		43 ..	20
		51 ..	16
		99 ..	12
13.	Animal Breeding Centre, Nikaweratiya ..	167 ..	14
		123 ..	14
		146 ..	17
		126 ..	11
		124 ..	16
		125 ..	19
14.	Animal Breeding Centre, Akkaraipattu ..	89 ..	18
		90 ..	14
		91 ..	7
		92 ..	21
		93 ..	6
		94 ..	18
15.	Experiment Station, Jaffna	27 ..	—
		30 ..	19
		31 ..	9
		34 ..	21
		35 ..	12
		43 ..	20
16.	Experiment Station, Wariyapola ..	43 ..	12
		44 ..	8
		45 ..	23
		57 ..	14
		62 ..	10
		69 ..	12
17.	Farm School, Wariyapola	21 ..	9
		22 ..	11
		38 ..	9
		41 ..	13
		63 ..	19
		66 ..	4
18.	Farm School, Karadianaru	54 ..	16
		58 ..	1
		60 ..	1
		68 ..	2
		70 ..	10
		71 ..	8